

**ESSAYS ON DYNAMIC VALUE CHANGE PERSPECTIVE IN RESOURCE  
BASED VIEW, DETERMINANTS OF ALLIANCE FORMATION AND RISK  
PREFERENCE IN ALLIANCE FORMATION**

A Dissertation

by

IK SU JUN

Submitted to the Office of Graduate Studies of  
Texas A&M University  
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2009

Major Subject: Agricultural Economics

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## **ABSTRACT**

Essays on Dynamic Value Change Perspective in Resource Based View, Determinants of Alliance Formation and Risk Preference in Alliance Formation. (December 2009)

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Chair of Advisory Committee: Dr. Desmond Ng

This dissertation focuses on addressing some critical shortcomings in recent developments of the field of strategic management with three essays; shortcomings in the ubiquitous Resource Based View (RBV) on matters regarding the origins and processes of value creation; shortcomings in alliance management capability (AMC) research with regard to explaining the determinants of alliance formation; shortcomings of a traditional portfolio theory based approach toward explaining risk preference in the formation of alliances.

The second chapter of this dissertation deals with the first essay. This chapter argues value originates from a basic asymmetry in the perceptions and resources of various stakeholders in a value chain –consumers, firm, and suppliers. Such asymmetry inherently occurs due to bounded rationality and resource constraint of the stakeholders. However, this asymmetry evolves through competitive interactions among stakeholders. Thus, this chapter develops a dynamic approach to firm value creation emphasizing interactions between a firm's internal growth processes and external changes in its market environment.

The third chapter of this dissertation, the second essay, focuses on the missing determinants of strategic alliance formation in an alliance management capability (AMC) explanation. This chapter suggested three missing factors: 1) basic limits in the number of alliances a firm can effectively manage, 2) absorptive capacity, and 3) a firm's external competition in explaining the formation of alliances. This chapter empirically supports these missing determinants significantly impact the formation of alliances especially at different types of alliances such as exploitive and explorative alliances. Exceptionally, however, the basic limits in the number of alliance to manage does not significantly impact the total number of alliance formation.

The fourth chapter of this dissertation, the third essay, examines a firm's risk preference with regard to its choice of risk alliances. Based on prospect theory and behavioral theory, this chapter aims to resolve the research question of why firms form risky alliances when such alliances yield low returns. According to risk preference research, a firm is a risk seeker when its returns fall below a reference point and conversely becomes risk averse when its returns rise above this reference point. This study empirically examines and supports this argument.

**DEDICATION**

*To my personal Savior and my family: My wife, Su-jin; my daughter, Yujin*

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## CHAPTER I

### INTRODUCTION

During the last two to three decades, the field of strategic management has been highly developed in the growth of theoretical and empirical research “in the study of business and organizations” (Hoskisson, Hitt, Wan, & Yiu, 1999: 418). However, some dominant but recently developed views in the field of strategic management face several shortcomings that require further theoretical and empirical research. Specifically, this dissertation seeks to address the shortcomings of Resource Based View (RBV) regarding the origins and processes of value creation, in alliance management capability (AMC) research in regards to the determinants of alliance formation, and lastly traditional portfolio theory approach in regards to explaining risk preference in alliance formation.

The first essay of this dissertation is related to resolving shortcomings on the Resource Based View (RBV) which has been a dominant perspective in strategic management. The focus of the RBV is explaining a firm’s value through an emphasis on the ‘the resources’ of the firm. The RBV attributes a firm’s performance to the value (V), rareness (R) and Inimitability (I) traits of a firm’s resources. Firms with V and R resources are argued to be a source of competitive advantage while firms with V, R and I resources are argued to sustain the firm’s competitive advantage (Barney, 1991; Priem & Butler 2001a). However, the value (V) is assumed to be a given and exogenous to the

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This dissertation follows the style of *Academy of Management Review*.

firm. Hence, the RBV does not provide a firm level explanation of value. Furthermore, attributing a firm's value to external markets is problematic because value is subject to evolutionary processes to which has been largely ignored by the static orientation of the RBV. Thereby, the RBV has been criticized for the lack of explanations on the origin of value and the process of value creation because RBV researchers have assumed that the value originates from outside of a firm and a firm's external market is constant (Priem & Butler, 2001a; Sirmon, Hitt, & Ireland, 2007). Furthermore, internal value process within a firm has remained as a 'black box' (Sirmon, Hitt, & Ireland, 2007). In addition, even though in a market there are dynamic interactions among stakeholders- consumers, firm and suppliers- that impact a firm's value creation process, the RBV has not considered these stakeholder interactions. Hence, the objective of the first essay of this dissertation is to address such shortcomings of the RBV regarding the origin and process of value creation. Specifically, this essay develops a theoretical model of value creation that not only accommodates a multi-stakeholder approach to value creation (supplier, firm and consumer), but as consequence yield co-evolutionary interactions to explaining dynamic sources of value creation to the RBV.

The second essay of this dissertation is related to resolving shortcomings in alliance management capability (AMC) research. A basic premise of the concept of AMC is that firms with experiences in managing alliances are better positioned to leverage their past experiences in managing future alliances and thus suggesting that a firm's AMC positively influences a firm's formation of alliances. Although AMC provides insight to explaining the formation of alliances, there are also other critical

factors- the number of alliance a firm could / should manage, absorptive capacity and competition- that are missing in AMC explanations. Furthermore, the AMC explanation does not consider the effects of these factors on the formation of different types of alliance. Although there are many possible classifications of alliances in high technology sectors, such as biotechnology, alliances vary in their risk-return relationship. Such risk-return relationships are reflected by exploitation – low risk, low return- and exploration –high risk, high return- alliances. Hence, the objective of the second essay of this dissertation is to further advance understanding of not only the determinants of the formation of a firm's overall number of alliances, but also the formation of these specific forms of alliances: exploitation / exploration alliances. In explaining the formation of these alliances, this study develops a theoretical and empirical examination of an AMC explanation that is augmented with diminishing return effects, absorptive capacity and competition arguments.

The third essay of this dissertation is related to resolving shortcomings in traditional risk preference approach regarding alliance formation. The traditional risk preference approach that is based on financial portfolio theory does not fit the empirical phenomenon in alliance formation. That is, evidence appears to suggest that unlike the predictions of financial portfolio theory, a firm's decision to invest into an alliance is not based on a positive risk-return framework. Evidence suggests that firms form risky alliances with low return. For instance, in a pharmaceutical industry the rate of an approved drug of a high risk alliance was reported as 14% while that of a low risk alliance was 26% (Lerner, Shane, & Tsai, 2003; Rothaermel & Deeds, 2006). This

seems to be the case of the 'risk/return' paradox that challenged the traditional financial portfolio theory (Fiegenbaum, Hart, & Schendel, 1996). Hence, the objective of the third essay of this dissertation is to provide an alternative explanation to the risk/return paradox in alliance formation. Specifically, this essay seeks to examine a firm's preference for risky or high risk alliances by drawing on prospect theory and related behavioral theory to resolve the research question of why firms form risky alliances with low returns.

In organizing this dissertation, these three essays are discussed in Chapter II, Chapter III, and Chapter IV respectively. Overall summary and suggestions for further research are discussed in Chapter V.

## **CHAPTER II**

### **DYNAMIC VALUE CHANGE PERSPECTIVE**

### **INTO RESOURCE BASED VIEW**

#### **INTRODUCTION**

A basic assertion of the resource based view (RBV) is that it assumes resources are “valuable” (Barney, 1991; Priem & Butler 2001a; Rumelt, 1984). However, RBV has not clearly answered the question of what the origin and process of the value is? Despite the significant influence of the RBV to management research, there remains considerable debate on the sources or causes of such value (Bowman & Ambrosini, 2001; Lepak, Smith, & Taylor, 2007; Priem, 2007; Priem & Butler, 2001a). For instance, debate between Priem and Butler (2001a, b) and Barney (2001) suggested that the value of a firm’s resources stems from “outside of a firm” whereby according to Priem (2007) such value is determined by the consumer. Thus, Priem (2007) argues that the RBV needs a greater attention to such sources of value. Yet sources of value also stem beyond that of the customer. This is because, and especially in the context of an agricultural value chain, value is the result of the combination of multiple technologies or resources that are not possessed by any one firm in their entirety. In other words, a firm’s supplier of rare inputs can also contribute to a firm’s value. Hence, a limitation of the RBV is it not only fails to sufficiently consider value from a consumer perspective –as has been argued by Priem (2007) but also the interactions among stakeholders of the value chain (e.g. Peteraf & Barney, 2003: 313).

Furthermore, the RBV (Barney, 1991) has been criticized for its largely static explanation of value and as a consequence is unable to provide process view of value creation (Priem and Butler, 2001a). Yet earlier developments of the RBV have attributed value to a firm's internal growth process (Barney & Arikan, 2001). For instance, Penrose (1959) argued that value stems from an internal growth process in which a firm's value stems from "the way resources are accessed and used" (Moran & Ghoshal, 1999: 391). Penrose attributes value to an internal processes of discovering the varied and untapped uses of a firm's resources (Kor and Mahoney, 2000; Ng, 2007). Hence, although value creation is ultimately tied to a firm's ability to respond to consumers' need, especially as prescribed by more recent extensions of the RBV (i.e., Priem), such extended explanation about the sources of value is incomplete. This is because RBV explanations not only fail to consider the value contributed by a firm's suppliers whose outputs are necessary for the creation of products to satisfy the needs of its consumers, but also for a firm's internal growth process (i.e., Penrose). Such a depiction underscores that value stems from a dynamic or co-evolutionary process that arises from interactions between the supplier, firm and the consumer. However, because RBV treats value in highly static terms (e.g., Peteraf & Barney, 2003), such a dynamic or co-evolutionary explanations of firm value creation remain largely unspecified.

As a result, the objective of this study is to develop a theoretical model of firm value creation that not only accommodates this multi-stakeholder approach to explaining the creation of a firm's value, but also as a consequence of this multi-stakeholder approach yields a co-evolutionary view of firm value creation. Specifically, this study



argues this dynamic process is attributed to bounded rationality and to the resource constraints of stakeholders. This is because since bounded rationality yields a trial and error experimentation process, a model based on bounded rationality thereby cannot yield a static equilibrium outcome. As a result, this study argues the stakeholders are not only boundedly rational (Simon, 1982), but as a consequence yield a process of value creation that is inherently dynamic. Furthermore, stakeholders' behaviors are not only constrained by the cognitive limits imposed by bounded rationality, but the stakeholders' behaviors are also influenced by their resource constraints. These resource constraints enhance the dynamic interactions among the stakeholders because they seek to address their resource constraints and firms can create value through addressing its own and other stakeholders' resource constraints.

To elaborate, in explaining the value creation process bounded rationality and resource constraints underlie the concepts of cognitive gap and operational gap respectively (Lavie, 2006). In drawing on Lavie's ideas of a cognitive and operational gap, these gaps refer to two distinct sources of value creation. A cognitive gap attributes value from the development and discovery of potential products / services through discovering or diversifying untapped uses of a firm's input resources. Operational gap attributes value from the improvement of a firm's inability to fully utilize its current productive capacity. Yet, as a firm's value is influenced by its stakeholders, the firm creates value also from recognizing and exploiting the cognitive and operational gaps of other stakeholders-consumers and suppliers. This is because the cognitive and operational gaps among the stakeholders in a market provide external opportunities for

firms that seek to recognize and utilize such gaps. In that, due to differences in the stakeholders' positions in the value chain, each stakeholder faces boundedly rational behaviors that are specific to their segment of the value chain and also faces unique resource constraints. As stakeholders hold different cognitive and operational gaps, a firm's value creation stems from exploiting such asymmetries. Value is thereby the result of a firm's ability to exploit the asymmetries amongst its stakeholder groups.

However, such value provides incentives for competition. Competition involves the recognition and exploitation by a firm's rivals of the cognitive and operational gaps of the value chain system. That is, a firm's rivals also seek to recognize and exploit the cognitive and operational gaps of the value chain system for their own value creation. This is in a sense different from neo-classical economics approach in which competition has been traditionally approached in terms of price or quantity. In this study, however, competition is approached in a more fundamental sense because the competition involves the gaps which are sources of a firm's value creation. Because the sources of a firm's value creation erode with competition, that is, the stakeholders' cognitive and operational gaps erode with competition, competition creates a crisis for the firm to seek new sources of value creation in which new paths of resource development arise.

To develop this line of reasoning, a firm's ability to recognize, develop, and create opportunities for value creation is critical to this co-evolutionary view of value creation (e.g. Cohen & Levinthal, 1990; Eisenhardt & Martin, 2000; Peteraf & Barney, 2003; Teece, Pisano, & Shuen, 1997; Venkataraman & Sarasvathy, 2001). Since value is created in a co-evolutionary process, changes in such value are influenced by a firm's

ability to recognize, exploit, and create such value. This study attributes this process of value creation to a firm's "internal resources mechanism" (IRM) which serves to recognize, exploit, and create a firm's own cognitive and operational gaps as well as its stakeholders' gaps. This IRM is rooted in the modern resources based concepts of absorptive capacity and dynamic capability. Absorptive capacity serves to "evaluate, assimilate, and apply new knowledge" (Cohen & Levinthal, 1990). While, dynamic capability enables the "reconfiguration" of a firm's resources to match and even create changes in the market (Eisenhardt & Martin, 2000; Teece, Pisano, & Shuen, 1997). These factors – absorptive capacity and dynamic capability that comprise a firm's IRM are argued to play critical roles in the co-evolutionary process of value creation because they serve in the recognition, exploitation, and even creation of the firm's own cognitive and operational gap as well as other stakeholders' cognitive and operational gap. However, as such cognitive and operational gaps are also sources of value for a firm's rivals, competition for such gaps encourages a firm's IRM to seek new path creating behaviors that involve a fundamental departure from a firm's established areas of competence (i.e. path creating).

In organizing this study, this study's unit of analysis, assumptions, and definitions are first stated. The conceptual foundations of this study's arguments are then developed. In particular, the bounded rationality and resource constraints of value chain stakeholders –supplier, firm and consumer - are explained in terms of their respective cognitive gap and operational gaps. These gaps are used to explain the dynamic behavior of the market. Yet because value is created through a co-evolution between that of the

stakeholders and the firm's internal resources mechanism (IRM), we then examine how a firm's IRM responds to the cognitive and operational gap of its stakeholders. Testable propositions are also stated from this IRM approach to value creation. The study concludes with its discussions, contributions and limitations.

## **CONCEPTUAL FOUNDATIONS**

### **Unit of Analysis: A Firm**

As the objective of this study is to explain the determinants and processes of a firm's value creation, this study's unit of analysis is based at the firm level. In particular, although the RBV typically attributes "value" to the external market environment, this study examines "value" from the perspective of a firm in its relationship to stakeholders of its value chain. Specifically, although value stems from the relationships that a firm has with stakeholders in the firm's value chain, i.e., a firm vs. consumer, and a firm vs. supplier, such sources of value is ultimately perceived from the point of view of a firm. This approach to value is also important in certain industries such as agribusiness (Woolverton, Cramer, Hammonds, 1985) because value creation is the result of multiple stakeholders. However, this study maintains the firm level focus of the RBV because, the internal growth processes of the firm – as discussed later by a firm's IRM- influence a firm's perceptions of value – cognitive and operational gap- amongst its stakeholders. As a result, the development of our theoretical arguments about the co-evolutionary

relations between a firm's internal growth and its stakeholders is taken from the point of view of the firm.

### **Assumptions: Bounded Rationality**

Unlike the perfectly rational behaviors of economic man, the behaviors of stakeholders – consumer, firm and supplier- are predicated on the assumption of bounded rationality. Bounded rationality is a basic and implicit assumption of strategic management research (e.g., Rumelt, Schendel, & Teece, 1994). Simon (1982) contends individual agents are boundedly rational because there are not only basic limits in the agent's knowledge, but also cognitive limits in their ability to process information. In particular, a key distinction in this study's use of the concept of bounded rationality is it underscores that although stakeholders do not “optimize” in a perfectly rational economic sense, they “attempt” to seek solutions towards a global objective or true optimal. Specifically this study assumes the existence of an objective reality to which there is an optimal solution. Yet, due to bounded rationality, such an optimal can not be recognized or reached instantaneously by the stakeholders. It is important to note that this assumption of bounded rationality is not identical with ‘constrained optimization’ of neo-classical economics. This is because bounded rationality is basically related to limitations in cognitive ability and knowledge of a decision maker while the constrained optimization in neo-classical economics assumes that decision makers perfectly know what the optimal decision is given constraints on their resources. The bounded rationality is well described by ‘cognitive gap’ and ‘operational gap’ suggested by Lavie

(2006) because boundedly rational behaviors and resource constraints are argued to contribute to cognitive gap and operational gap. Further explanations about the cognitive and operational gaps are discussed in the following section.

### **Conceptual Developments: Cognitive Gap**

To elaborate on these concepts, Lavie defined the concept of cognitive gap as the differences “between the actual value-maximizing capability configuration and the perceived value-maximizing capability configuration” (Lavie, 2006: 166). Cognitive gap represents the gap between the true / objective optimum and the currently perceived optimum. In the context of a value chain system, this study argues that stakeholders are subject to such forms of cognitive gaps. This cognitive gap arises because since stakeholders’ cognitive ability and knowledge are limited, they do not have full knowledge of the available set of choices. As a result, stakeholders make decisions based on their given knowledge set to which yield a perceived optimum that departs from an objective optimum.

To explain, consumers tend to place a value or utility on a firm’s products / services based on their experiences with the products / services. Hence, consumer will tend to choose and value a firm’s products / services in ways that maximize their utility given such experiences. However, because a consumer’s cognitive ability is imperfect there is other knowledge or information which is not processed within their given experiences (Hayek, 1945; Simon, 1982). Thus, although consumers appear to be optimizing their consumption of products, such optimizing behaviors are based on

incomplete knowledge experiences and thereby their choices and resulting valuations reflect a perceived optimum. Such a perceived optimum deviates from an objective or true optimum because there are other experiences not accounted for by the consumers. There is in a sense an objective or global optimum that reflects valuations of a firm's products / services based on a broader set of knowledge experiences that has not been known by the consumers. The consumer's untapped needs are likely to be included in the broader set of experience. Thus, due to limits on consumer's knowledge or cognitive ability in gaining understanding of these other experiences, the consumer faces a "cognitive gap" which reflects the consumer's untapped need and unrecognized uses and values of a firm's products / services.

Similarly due to bounded rationality, the firm is also subject to a cognitive gap. The cognitive gap of the firm arises from the firm's inability to fully utilize the untapped product uses (i.e. new products and services) of a firm's resources. The untapped uses of a firm's resources exist because due to bounded rationality there are heterogeneous uses or applications of firm resources that are not fully comprehended by the firm. Namely, a firm's resources are heterogeneous not only in terms of their physical attributes, but also in their applied uses (e.g., Penrose, 1959; Ng, 2007). Yet, although a firm's resources can be applied in different ways to yield different products and services, the ways in which such a resource can be used is limited by the knowledge experiences of the firm (Penrose, 1959). Hence, similar to the consumer explanations, the firm chooses a set of resources that yield a perceived optimum that deviates from an objective or true optimum because there are other experiences not accounted for by the firm. That is,

there is an objective or global optimum that reflects valuations of a firm's heterogeneous uses of resources that is based on a broader set of knowledge experiences that is not known by firm. Hence, due to limits on rationality, a firm does not have full knowledge of the varied possible uses of its resources, the firm faces a cognitive gap in regards to realizing the untapped or potential products / services that can be rendered from their heterogeneous resources.

With respect to the supplier's cognitive gap, it reflects a basic discrepancy between perceived use of its output and the output's optimal. The supplier does not comprehend all alternative use for the demand of its product<sup>1</sup>. In essence, the supplier's cognitive gap reflects discrepancies between the supplier's perceived demand for its products and that of an objective demand. Such discrepancies arise because since the outputs produced by the supplying firm are but only one of many possible inputs used by the purchasing firm, the supplier does not know the synergistic relationships between its output and the buying firm's use of other resources (Barney, 1986). As the purchasing firm possess knowledge about how its resources can be combined in ways that cannot be known by the supplying firm, the supplying firm thereby has limited knowledge of the varied use of its products. Therefore, due to bounded rationality, the supplier faces a cognitive gap in which it produces products for a purchasing firm that does not fully

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<sup>1</sup> Because the supplier is mostly a firm to produce its output the logic applied to a firm for its cognitive gap is also applicable to the suppliers. Yet, we do not do so because since the firm is the primary unit of analysis, the firm's perceptions –due to limits on bounded rationality- constrains the scope of the analysis to the output aspects of the supplier's choices. In other words, due to limits on bounded rationality, the firm can only provide attention to the demands for its product from consumers as well as the firm's resource demands it places on its supplier's output. The supplier's own input (resource) choices are beyond the scope of the firm decisions.



account for the varied potential uses that are desired by the purchasing firm.

### **Operational Gap**

Unlike the concept of a cognitive gap, an operational gap arises when the firm and stakeholders have difficulties in reaching their perceived optimum. Firm and stakeholders face difficulties in reaching this perceived optimum because of a lack of resources or geographic constraints. The discrepancy between a perceived optimum and a stakeholder's current productive state or capacity is described by the concept of operational gap. For instance, consumers face budget or geographical constraints in consuming the products / services that satisfy their perceived utility. In other words, there occurs the discrepancy between the consumer's perceived optimum and his / her capacity due to budget or geographic constraints. The operational gap is also affected by change in cognitive gap because a consumer's perceived utility is varied by change in his / her cognitive gap, such as discovering his / her untapped need. A new product / service enables a consumer to recognize his / her untapped need or utility and as a result increase his / her perceived optimum. Yet, because the new product / service tends to be expensive or limited in distribution at the beginning, it increases the consumer's operational gap.

With respect to a firm's operational gap, its current resource configuration may not be sufficient to reaching its perceived optimum scale and scope because of a lack of complementary resources and capabilities (Lavie, 2006; Penrose, 1959). A firm's operational gap is also affected by change in its cognitive gap because the firm's

perceived optimum of its resource use is varied by change in the cognitive gap, such as introduction of a new innovative technology. The new innovative technology may enable the firm to recognize its untapped use of existing resources and capabilities and as a result increase its perceived optimum in configuration of its resources and capabilities. However, the new technology also increases the need of complementary resources and capabilities to enable its new perceived optimum to be embodied. In other words, the new configuration of the firm's resources to reach the new perceived optimum may increase the need for complementary resources.

While, the operational gap of the supplier is the discrepancy between the perceived use of its output (i.e. scale and scope) and the supplier's productive capacity. The operational gap of the supplier occurs because the supplier does not have access to resources that enable it to fully utilize its productive capacity in ways that allow it to operate at its perceived optimum. However, because this study is based on firm level analysis, this study does not focus on the supplier's input resource constraints in reaching its perceived optimum but on the discrepancy of the supplier's output from its perceived optimum. The supplier's perceived optimum is rather recognized by a purchasing firm's demand. As a result, the supplier's operational gap is also changed by the change in the purchasing firm's demand. In other words, when a (purchasing) firm's demand is changed, the supplier faces difficulties adjusting to it instantaneously because the new demand may need the changes in the supplier's productive facilities.

## Sources of Firm Value

**From a firm's relationship with consumers in its value chain.** The firm exploits the consumers' cognitive gap by developing novel products and services to meet the untapped needs of its consumers. In that, through the firm's product /service introductions, value is rewarded to the firm for having discovered needs previously unknown to the consumers. For instance, upgrading the quality of the products by adding new features or functions, removing some features, and advertising the new products and services are ways in which a firm can uncover the unrealized preferences of consumers and thus provide a means to exploit their cognitive gaps. Hence, unlike the rationality assumption of neoclassical economics, consumers' preferences are not fully defined nor fully known by the consumer. Rather, such preferences are informed and discovered by the innovative efforts of the firms (Carpenter & Nakamoto, 1989). The firm can also exploit a consumers' operational gap by providing products and services in which the budget constraints or geographic constraints of the consumers are taken into account. This would involve, for instance, products with more attractive price points and / or expansions in transportation and distribution logistics, such as utilization of a firm's established distribution channel or an alliance with a better distribution company. Hence, relative to cognitive gaps, the exploitation of operational gaps involves relatively less innovative developments in products features. The exploitation of operational gaps is not on revealing untapped consumer preferences but rather to reveal product features that relieve the constraints of the consumer. As a result, consumers' cognitive and operational gaps are a source of value for the firm because it provides opportunities for

the firm to develop ‘novel’ products and services that meet the untapped needs of the consumer and also to develop ‘appropriate’ products that meet the budget and geographical constraints of its consumer (Lepak et al., 2007).

**From a firm’s relationship with suppliers in its value chain.** Given the cognitive and operational gaps of suppliers, exploitation of these gaps by the firm offers another source of firm value. Value stems from the firm’s ability to exploits the cognitive and operational gaps of its suppliers through asymmetric information advantages. The firm is able to exploit the cognitive gaps of its suppliers because the firm has better knowledge about the various ways in which the supplier’s products can be used than the supplier. This is because unlike the supplier, the firm combines the outputs of the supplier with the firm’s current other resources to which provides the firm access to synergy effects that cannot be known by a single supplier (Barney 1986; Lippman & Rumelt, 2003b). Thus, knowledge of the potential as well as existing synergies between the various resources of a firm provides the firm an asymmetric information advantage that enables the firm to discover untapped uses that are not previously known by its supplier. Hence, by exploiting such asymmetric knowledge advantages, the firm can thus exploit the cognitive gaps of its supplier. In particular, this asymmetric information advantage in exploiting the supplier’s cognitive gap provides the firm greater bargaining power over its supplier. This is because a firm can develop new demands on the output of the supplier based on the new use of the supplier’s product. A firm’s new demand on the use of the supplier’s output also increases the supplier’s operational gap because the supplier can not respond instantaneously to the

new demand of its output. The firm exploits the supplier's operational gap through sharing certain technology with the supplier because the exploitation of the supplier's operational gap rewards the firm with better or more appropriate outputs of the supplier that are used as the firm's resources for its products / services.

**From a firm's internal cognitive gap and operational gap.** The RBV has been criticized for its lack of attention to the causes of value and the RBV researchers have assumed that the value comes from outside of a firm (Priem & Butler, 2001a; Sirmon et al., 2007). However, the sources of value are not exclusive to the conditions of a firm's external environment. A firm's value also stems from its internal cognitive and operational gaps because a firm is also boundedly rational and faces resource constraints. As a firm recognizes and exploits its own cognitive gap and operational gap, economic value will be rewarded to the firm. Specifically, as a firm's cognitive gap in which heterogeneous uses or applications of firm resources are not fully comprehended by the firm is recognized and exploited, a firm's resources can be applied in different ways to yield different products and services. That is, a firm is better able to utilize the untapped product uses (i.e. new products and services) of a firm's resources through recognition and exploitation of its cognitive gap. The firm value is also increased through exploitation of the firm's operational gap. Efficiency enhancement in resource configuration to produce certain products /services can save a firm's production cost. Furthermore, the recognition and exploitation of the firm's operational gap is easier than those of its cognitive gap because the firm's prior experience has learning effect on the recognition and exploitation on the operational gap. For instance, due to knowledge

accumulation through experience the efficiency enhancement in resource configuration for a certain product is easier than the invention or discovery of a new product / service.

In sum, as the firm seeks to exploit not only its internal cognitive and operational gaps, but also that of its consumers and suppliers, the exploitation of these cognitive and operational gaps serves to provide a firm's source of value. The following is thus proposed:

*Proposition 1: The cognitive and operational gaps of a firm and its stakeholders in a value chain – consumer and supplier- are positively related to opportunities for a firm's economic value.*

## **MARKET DYNAMISM**

### **Exploitation of Opportunities from Competition**

However, since stakeholders' cognitive and operational gaps are a source of value (proposition 1), these gaps provide incentives for competition. As competitors seek to exploit the cognitive and operational gaps of the stakeholders, the reductions in such gaps impact the firm's relationships with its stakeholders. The influence of such competition on a firm's stakeholder relationships are discussed in the following.

**From a firm's relationship with its consumers.** A firm's ability to recognize and exploit the cognitive and operational gaps of its consumers declines with increasing competitions. Namely, when a firm exploits the consumers' cognitive gap and operational gap, the opportunities associated with such exploitive efforts induces

competition, such as entry by a firm's rivals, to satisfy the untapped needs (cognitive gap) and untapped efficiencies of the consumers (operational gap). For instance, Starbucks, a dominant coffeehouse chain, has been increasingly challenged by new competitors such as McDonald's (Pressman, 2007). During this competition, certain information about the consumer's preferences for coffee, such as preferences for high quality traits involving coffee blends and service traits become increasingly revealed through the rivals' competitive offerings. As a result, such competition not only serves to reveal new product and service attributes but as a consequence serve to further exploit consumer's cognitive gap. Thus as competition amongst rival firms becomes intense, rival firms operate on increasingly similar information about the untapped needs of the consumers and thus leading to a reduction of the consumers' cognitive gaps. This is evidenced by the development of similar products and services among rival firms as in fast food or coffee industry.

Competition not only reduces consumers' cognitive gap, but can also reduce the consumers' operational gap. Competition promotes efficient production methods and distribution systems to which result in decreased market prices and greater product availability. Competition thereby reduces a consumer's operational gap by satisfying the consumer's budget and or geographical constraints. Furthermore, as more alternatives are offered by the competitors, the operational gap of consumers further declines. That is, a greater affordability and availability of products / services due to competition relax budget and geographical constraints of the consumer. Hence, competition increases exploitation of consumers' operational gap.

**From a firm's relationship with suppliers.** Competition by the firm's rivals can also reduce the cognitive and operational gaps of a firm's suppliers. Although a firm has an asymmetric knowledge advantage over the varied and thus potential uses of its supplier's output products, competition serves to reveal a greater set of potential and untapped uses that cannot be known by the individual firm. Namely, in the aggregate, competitors possess greater knowledge about the varied uses of a supplier's outputs than can be known by the single firm. Hence, as competition provides new ways to utilize the outputs of the supplying firm, this competition reduces the supplier's cognitive gap. As a consequence competition mitigates the asymmetric knowledge advantages of the firm and thereby reducing the firm's influence on the products of the supplier. That is, the influence of the firm on the demand of the supplier's product is gradually decreased due to the competition. Competition also serves to reduce the suppliers' operational gap. New uses for a supplier product are revealed through the competitive process and thus increases in the supplier knowledge about the use of its output will improve its productive capacity.

In sum, although cognitive and operational gaps of stakeholders are sources of a firm's value, competition, however, erodes the cognitive and operational gaps of its stakeholders. The reduced opportunities either favors an exit of firms from the market, or places increasing pressures for existing firms to create new sources of value (Astley, 1985; Kim, 1998). The creation of new sources of value involves a fundamental broadening or enlarging stakeholders' cognitive gap and operational gap. This arises through a process of value creation through innovation. Although innovation is



commonly associated with the creative efforts of the individual firm, this study, however, argues that the process of value creation involves interactions between the firm and its various stakeholders. These firm-stakeholder interactions are explained in the following.

### **Value Creation through Innovation**

**A firm's relationship with its consumers.** As competition reduces the cognitive and operational gaps of a firm's stakeholder groups, the firm is more likely to undertake 'value creating behaviors' that extend beyond the recognition and exploitation of the stakeholders' existing cognitive and operational gaps. Innovation is central to the value creating behaviors. As innovations introduce new needs that are not previously recognized or even understood by consumers (e.g., Starbucks, IPODs), a firm's innovation increases the consumers' cognitive gap. Innovations increase the consumer's cognitive gap through increases in their true optimum by shaping or forging new demand preferences that were not previously known by the consumer, such as in the case with Starbucks.

Increases in cognitive gap can also lead to increases in operational gap because innovations not only increase the true optimum but also through the consumption of such novel products, the acquisition of new experiences increases the consumer's perceived optimum. Hence, the difference between the new perceived optimum and the consumer's current consumption state also increases. That is, because new innovative products / services are typically sold at a premium, a consumer's current budget or geographical constraint precludes the consumer from the purchase of these products. The consumer's

operational gap is thereby increased with innovation. For instance, Apple's introduction of innovative products such as IPODS and MacBook not only revealed radically new products that expanded the consumer choice set and thus true optimum, but because of their premium pricing, these products increased the consumer's operational gap.

**A firm's relationship with suppliers.** The creation of cognitive gap and operational gap through innovation also arise to the firm-suppliers interface. As competition reveals new valued uses for a supplier's output, decline in the firm's bargaining power over its suppliers induces a greater attention to the discovery of new combinations of complementary resources that yield new or unintended uses not previously envisioned by the supplier. This can involve the formation of strategic alliances that support the discovery of new resource combinations and synergies (e.g., Das & Teng, 2000; Eisenhardt & Schoonhoven, 1996). For instance, pharmaceutical firms have been found to form R&D alliances with start-up biotech firms so as to support the discovery of new configurations of resources and capabilities to which increases the likelihood of discovering the new and untapped resources use for the firm. Because alliances are more commonly formed among partners with similar experiences, the supplier firm is not able to access those alliances formed by the purchasing firm. As a result, it is difficult for suppliers to recognize those resource combinations and synergies that are discovered by the firm. Hence, through the firm's discovery of new resource combinations, such as through the formation of alliances, this discovery increases the suppliers' cognitive gap to which increases the firm's bargaining power over its suppliers. With respect to the supplier's operational gap, it is increased by

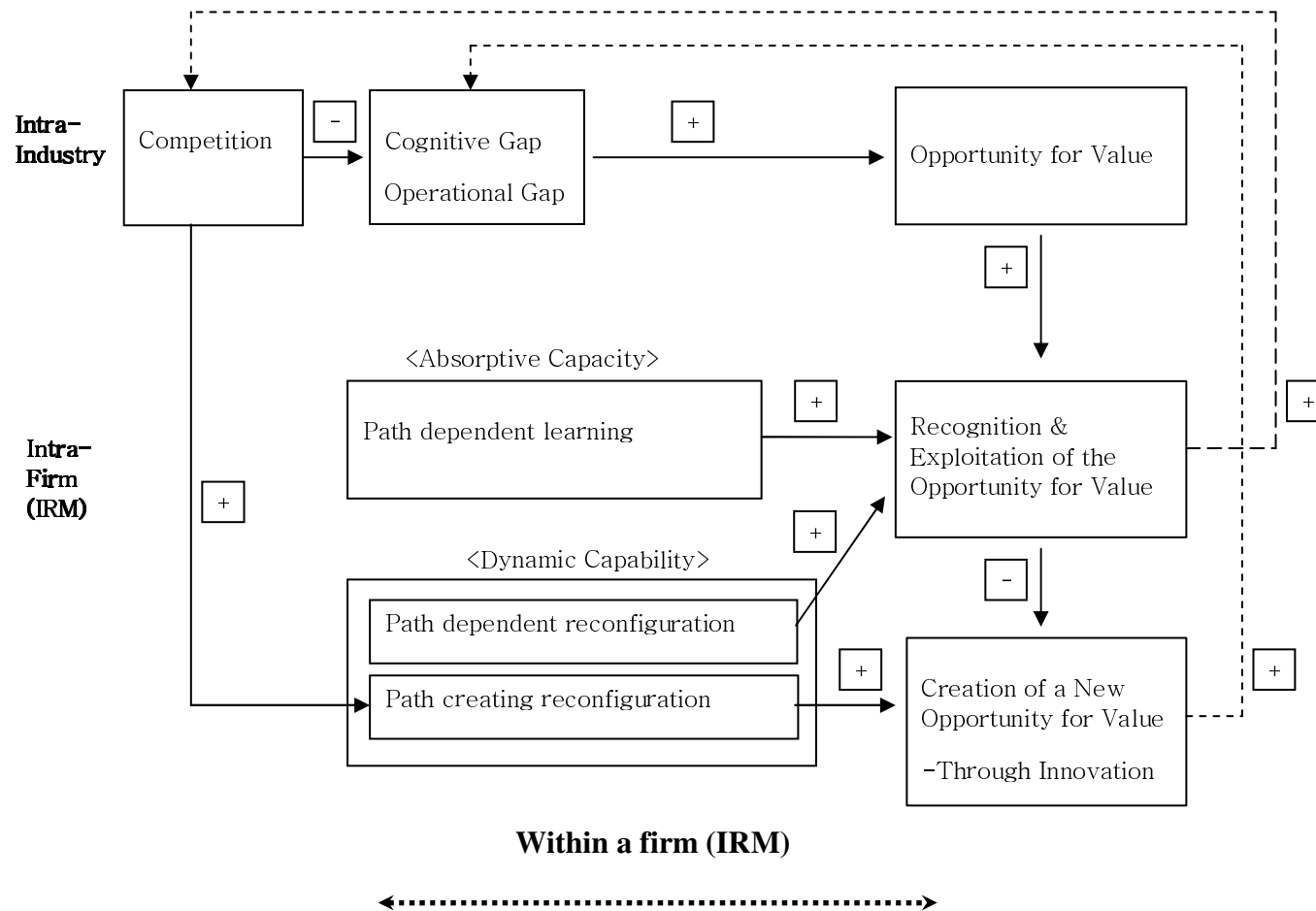
innovation because as a firm's innovations create new input demands, such demands involve the differentiation of the supplier's product, such as upgrading quality of the existing outputs of the supplier. The adaptation to the new demand may require the supplier to improve or change their current productive capacity. The supplier may need to make more investment in facilities and human capitals to improve or change its current productive capacity. Thereby its operational gap is enlarged by the innovation.

These arguments, thereby, suggest that although innovation is central to the creation of firm value, innovation is however induced by competition. Namely, competition has two effects to the value process. Competition serves to not only erode the stakeholders' cognitive and operational gaps and thus reducing a firm's value but such declines serves to induce the discovery of new sources of value. That is, competition creates a crisis that induces a firm to innovate new sources of cognitive and operational gaps to its various stakeholders. Such innovation entails a distinct departure from a firm's past experiences (Kim & Mauborgne, 1997). For instance, Kim (1998) argued that Hyundai Motor, a Korean car maker, intentionally evoked an internal crisis to reshape itself. In other words, due to pressures from competition, the firm created a new path involving the deployment of resources in an innovative manner, which is necessary to create value among stakeholders through increase in their cognitive gap and operational gap. As result of these stakeholder interactions, a firm's value undergoes a dynamic process proposed by the following.

*Proposition 2: A firm's value – as attributed to the cognitive gaps and operational gaps of the market system – is non-monotonically (U shape) related to a firm's competition.*

As the RBV has been criticized for its lack of attention to explaining the causes and process of value, the aforementioned discussions serve to rectify these limitations. However, the sources of firm value and processes of the value creation are not exclusive to the conditions of a firm's external environment. A firm's value creation is affected by its ability to discover and exploit its internal cognitive and operational gaps. Specifically, this study argues in the following discussions that a firm has internal resources mechanism (IRM) that serve to not only exploit its internal cognitive and operational gaps, but this IRM also coevolves with the cognitive and operational gaps of its stakeholders (e.g., Helfat & Raubitschek, 2000; Levinthal & Myatt, 1994). Thereby to complete our argument of the value process we need to investigate the relationship between the value process of the market and a firm's internal resources mechanism (IRM). To explain this relationship, the firm's 'internal resources mechanism (IRM)' is first outlined and then its relationship to the stakeholders' cognitive and operational gaps follows (see also figure 1).

Figure 1  
Co-evolutionary Process between a Firm's IRM and Its External Market



## **INTERNAL RESOURCES MECHANISM (IRM)**

### **Key Components of the IRM: Absorptive Capacity and Dynamic Capability**

Since value is a product of both a firm's resources and from the market value process, the purpose or function of a firm's internal resources mechanisms (IRM) – consisting of the concepts of absorptive capacity and dynamic capability—is to recognize, exploit and create value opportunities from a firm's internal and external environments. These concepts reflect more modern treatments of the resource based view (RBV), which have a distinctly dynamic orientation that focuses on the internal growth processes of the firm. A firm's internal growth processes involves the recognition, exploitation and creation of its cognitive and operational gaps. Specifically, the function of a firm's absorptive capacity and dynamic capability is to recognize, exploit, and create these gaps in distinct ways.

**Absorptive capacity.** The function of a firm's absorptive capacity is to recognize and exploit a firm's operational gap. The concept of absorptive capacity was developed by Cohen and Levinthal (1990) which refers to a firm's ability to evaluate and assimilate external knowledge for the purposes of creating commercialized products / services. A key empirical finding on absorptive capacity research is that a firm's cumulative experiences positively impact the firm's ability to internalize external information (e.g., Cohen & Levinthal, 1989, 1990). That is, the concept of absorptive capacity argues that there are non-trivial costs associated with the internalization of new and external information to which such costs decline with a firm's experience. Because absorptive capacity tends to recognize and assimilate information that reinforces their

prior experiences, it promotes learning curve advantages that lead to improvements in the efficient uses of its existing resources. As a result, absorptive capacity is suited to recognizing and exploiting a firm's operational gap. This is because a firm's absorptive capacity can utilize its past experiences towards internalizing practices that leads to a more efficient utilization of its production activities. In that, a basic function of a firm's absorptive capacity is to recognize and assimilate external knowledge that leads to a configuration or reconfiguration of its current state of production activities that is closer to its perceived optimum (Zahra & George, 2002).

However, this commitment to reduce the operational gap mitigates the firm's effort to recognize and exploit its cognitive gap because as absorptive capacity is committed to evaluating and assimilating related information – information that is similar to prior experiences, it stifles innovation. That is, even though the path dependent orientation of the absorptive capacity helps to reduce operational gaps (Lavie, 2006), improvements in operational gap leads to a commitment to established behaviors. Thus, a firm's absorptive capacity is often trapped by its commitment to reduce the operational gap to its perceived optimum. As a consequence, although path dependency tends to increase organizational efficiencies and thus reduce operational gaps, it creates core rigidity within a firm (Leonard-Barton, 1992; Levinthal & March, 1993; Levitt & March, 1988). Furthermore, there are incentives for a firm to recognize and exploit its operational gap first rather than cognitive gap. This is because relative to the cognitive gap, a firm's operational gap is more readily recognized and exploited because a firm's accumulated experiences can be more readily leveraged to exploit operational gaps. As

the recognition and exploitation of cognitive gaps involves the discovery of untapped and even unrelated resources, such discoveries are unlikely to be related to a firm's past learning curve experiences. Hence, the exploitation of the operational gap is less risky and its returns are more certain than the exploitation of the cognitive gap and its return. Thereby, a firm's absorptive capacity tends to favor the recognizing and exploiting of its operational gap over those of its cognitive gap.

*Proposition 3a: A firm's absorptive capacity better recognizes and exploits its operational gap than its cognitive gap.*

However, as competition promotes an internal crisis, competition can induce revolutionary or "discontinuous" forms of learning (Kim, 1998). Specifically, as new forms of learning require an exposure to new external sources of information, competition induces a firm's absorptive capacity to broaden its assimilation of experiences. As new information is assimilated, a firm's absorptive capacity develops new ways to utilize their existing resources. During the process, a firm's cognitive gap is better recognized and as a consequence, the likelihood to yield new product innovations increases. The new product innovations serve to thereby exploit a firm's cognitive gap. Hence, competition serves to reduce the path dependent rigidities of a firm's absorptive capacity to which the assimilation of new experiences serves to develop new products that exploit the firm's cognitive gap.

**Dynamic capability.** In addition to a firm's absorptive capacity, a firm's IRM also consists of a dynamic capability. Unlike the concept of absorptive capacity, dynamic capability is not focused on the evaluation and assimilation of information, but



is focused on changes to a firm's resources configuration (Schreyögg & Kliesch-Eberl, 2007). Dynamic capability underscores that a firm's growth and survival rests on the reconfiguration of a firm's resources and capabilities to the changing conditions of the market (Eisenhardt & Martin, 2000; Teece et al., 1997). The reconfiguration of a firm's resources and capabilities can arise in a path dependent and / or path creating fashion. The former reconfiguration involves incremental changes to a firm's current resources configurations while the latter creates fundamental or radical changes to the resources configuration. These different reconfigurations impact the firm's cognitive and operational gaps differently. The path dependent reconfiguration reduces a firm's operational gap while the path creating reconfiguration increases both a firm's cognitive and operational gaps.

To explain, a firm's dynamic capability is first argued to reduce a firm's operational gap through path dependent changes in its resources and capabilities. This is because incremental change in a firm's resources and capabilities serves to reinforce the firm's core competences (Teece et al., 1997). Such incremental changes increase the efficiency among resources and capabilities which leads to improvement in attaining a firm's perceived optimum (Lavie, 2006; Nelson & Winter, 1982). Furthermore, such incremental change is supported by learning curve advantage through experience. Zollo and Winter (2002) argued that knowledge accumulation can be used as an input for a firm's dynamic capability because the assimilation of related knowledge experiences results in a reconfiguration of resources that is in closely proximity to a firm's

established experiences. Hence, such dynamic capability leads to improvements in operational efficiencies to which serves to exploit gains from a firm's operational gap.

*Proposition 3b: The path dependent function of a firm's dynamic capability exploits its operational gap better than its cognitive gap.*

However, unlike the concept of absorptive capacity, dynamic capability is not strictly path dependent (Leonard-Barton, 1992). This is because dynamic capability argues that the firm's internal change processes will match the extent of those changes in its external environment. For instance, when a firm faces intense competition, research shows that firm faces increasing pressures to deviate from their established paths (Astley, 1985; Garud & Karnoe, 2001). Hence, this study argues that under such competitive conditions, a firm's dynamic capability serves to create significant or non-incremental reconfigurations in the firm's resources and capabilities. As a consequence of such path creating changes, dynamic capability increases a firm's cognitive gap and operational gap.

To elaborate, since a firm's dynamic capability tends to match the conditions of the market, highly competitive conditions induce the firm's dynamic capability to fundamentally reconfigure its resources and capabilities. This reveals new combinations of resource uses that are unrelated to existing configurations of resources and capabilities. As a consequence, the 'non patterned and multidirectional' paths in resource combinations increase the likelihood to find new resource uses which are not constrained by a firm's prior knowledge of resource uses. Moreover, because the new resource uses are combined synergistically with other resources and capabilities, the likelihood to

create or discover newer resource uses also increases (Denrell, Fang, & Winter, 2003). The discovery of newer resource uses is therefore likely to increase a firm's cognitive gap because the new discovered or created resource uses change the objective optimum of the firm's resources configuration. The discovery of new resource uses also increases a firm's perceived optimum because the firm's current perceived optimum is reevaluated based on enlarged combination set with the newly discovered resource uses. However, despite the discovery of new resource uses the firm's current productive capacity is not instantaneously upgraded because the newly discovered resource uses are not likely to fit to a firm's current productive capacity without complementary resources and capabilities (Ng, 2007; Penrose, 1959). Thereby, this process to increase the cognitive gap through discovering new resource uses enhances the need for complementary resources and as a result increasing the operational gap. Thus, the increase in cognitive gap leads to increases in a firm's operational gap.

In addition, the knowledge of new resource uses will be utilized to create new products / services, which are likely to impact an established market in a Schumpeterian way, i.e., causing creative destruction. This follows dynamic capability research that argues the reconfiguration of resources in response to changes in market environment yields new paths of resource development even to create or shape the market environment (Eisenhardt & Martin, 2000; Teece, 2007). Thereby, a firm's dynamic capability not only matches the high competition of its external market, but also creates or shapes the change in the external market by increasing its cognitive gap and

operational gap through the fundamental reconfiguration of existing resources and capabilities.

*Proposition 3c: Competition in a market is positively related to the path creating function of a firm's dynamic capability.*

*Proposition 3d: The path creating function of a firm's dynamic capability increases its cognitive gap and operational gap.*

A firm's IRM –absorptive capacity and dynamic capability- not only serves to exploit its internal cognitive and operational gaps, but also shapes the cognitive and operational gaps of other stakeholders. In other words, a firm's internal growth process, as depicted by its IRM, co-evolves with the cognitive and operational gaps of its stakeholders. A firm's co-evolution with its consumers' and suppliers' cognitive and operational gaps is elaborated in the following sections.

### **A Firm's IRM and Value Processes: Value Recognition, Exploitation and Creation**

The primary functions of a firm's IRM -absorptive capacity and dynamic capability- is to recognize, exploit and create value opportunities from its internal and external environment. This section examines how a firm's absorptive capacity and dynamic capability distinctively influence the recognition, exploitation and creation of the cognitive and operational gaps of its consumers and suppliers.

**Absorptive capacity and stakeholder cognitive and operational gaps.** A firm's absorptive capacity basically involves the recognition and exploitation of the cognitive and operational gaps of its stakeholders because absorptive capacity serves to

evaluate and assimilate new or external information to commercially utilize it. For the firm-consumer interface, a firm's absorptive capacity serves to recognize and exploit cognitive and operational gaps of its consumers. Because a firm's absorptive capacity is path dependent, the recognition and exploitation of a consumers' untapped need (cognitive gap) and budget or geographical constraints (operational gap) are constrained by the firm's prior experience. That is, a firm may have difficulties in recognizing and exploiting the cognitive and operational gaps of consumers beyond the firm's prior experience.

Hence, a firm's absorptive capacity favors the exploitation of the operational gap than that of cognitive gap of the consumer. That is, the learning curve advantage through leveraging prior knowledge or experiences through a firm's absorptive capacity is larger at exploiting the consumers' operational gap than their cognitive gap. The exploitation of consumers' operational gap, such as satisfying their budget or geographical constraints, is closely related to a firm's marketing strategies of given products and services. Prior marketing strategies are accumulated within a firm's absorptive capacity and relatively easily utilized for other products and services. A firm's absorptive capacity exploits the consumers' operational gap through refining its prior knowledge or experience by assimilating related knowledge. Specifically, the firm leverages its prior knowledge about lowering price of products / services to meet the consumers' budget constraints. The firm can also utilize its prior experience about distribution of its prior products / services to better mitigate the consumers' geographical constraints. Hence, the leveraging of prior knowledge or experience through absorptive capacity will increase a

firm's operational efficiency in its resources configurations that will lead to better exploitation of the consumers' operational gap. On the contrary, the exploitation of the consumers' cognitive gap, such as satiating their untapped needs, is likely to be closely related to development of a new product / service or a new technology that has not been in a firm's learning curve. A new product / service or a new technology development usually takes more time and higher cost, and its outcome is more uncertain than the marketing strategies and their outcomes do. Thereby, there are high incentives for a firm to favor the exploitation of the consumers' operational gap than that of their cognitive gap through leveraging prior experience through the firm's absorptive capacity.

*Proposition 4a: A firm's absorptive capacity better exploits the consumers' operational gap than their cognitive gap.*

However, when external competition is severe, a firm faces more pressure to exploit the consumers' cognitive gap because such competition promotes an internal crisis to which induces revolutionary changes in behavior, such as its learning (Kim, 1998). Specifically, as new forms of learning require an exposure to new external sources of information, competition induces a firm's absorptive capacity to broaden its assimilation of experiences. As new information is assimilated, a firm's absorptive capacity develops new ways to utilize their existing resources. During the process, the consumers' cognitive gap is recognized and exploited and as a result, the likelihood to yield new products / services is increased. The new products / services serve to exploit the consumers' cognitive gap. Hence, competition serves to reduce the path dependent

rigidities of a firm's absorptive capacity to which the assimilation of new experiences serves to develop new products that exploit the consumers' cognitive gap.

With respect to a firm-supplier interface, a firm's absorptive capacity also serves the recognition and exploitation of the cognitive and operational gaps of its suppliers. Because a supplier's output is combined with the firm's other resources, the firm has a greater breadth of experiences in the use of the supplier's output relative to the supplier. This is because the synergic effect between the supplier's output and the firm's other resources cannot be known by the supplier. The broader experiences on the use of the supplier's output are utilized through the firm's absorptive capacity to recognize and exploit the supplier's cognitive gap. The firm exploits or reduces the supplier's cognitive gap by creating new demand for the supplier's output, such as different quality of output, which is not known by the supplier. However, this new demand for the supplier's output is highly constrained by the firm's prior experience or knowledge within its absorptive capacity.

Unlike the exploitation of supplier's cognitive gap, the supplier's operational gap is exploited through a firm's providing incentives or pressures for the supplier to improve its own productive capacity. As a firm's knowledge about the use of the supplier's output is increasingly refined through its absorptive capacity, the firm's refined knowledge is more likely to be embedded in its demand on the supplier's output. The firm's more refined demand enables the supplier to better recognize its deficiency in its productive capacity, i.e., reason of its inability to meet the firm's demand. This is likely to provide larger incentives for the supplier to improve its productive capacity to

meet the demand of the firm. This is the way a firm exploits its supplier's operational gap through its absorptive capacity. Thereby, the supplier's operational gap is less directly exploited than the supplier's cognitive gap because the supplier's cognitive gap is more closely recognized in the firm's various combinations of resources and the supplier's output.

*Proposition 4b: A firm's absorptive capacity better exploits the suppliers' cognitive gap than their operational gap.*

**Dynamic capability and stakeholder cognitive and operational gaps.** A firm's dynamic capability causes changes in its resources configurations and as a result impacting the relationship with its stakeholders such as consumers and suppliers. A firm's dynamic capability reconfigures its resources configurations to exploit the stakeholders' cognitive and operational gaps as well as to create their new cognitive and operational gaps, which would be discussed later. The exploitation of the stakeholders' cognitive and operational gaps is supported by incremental changes in the firm's resources configurations through the firm's path dependent function of its dynamic capability. This is because a firm's dynamic capability is -to an extent- influenced by path dependent process (Teece et al, 1997; Zollo & Winter, 2002). That is, a firm's dynamic capability is influenced by learning curve advantage such as prior experience in resources configuration.

With respect to a firm-consumer interface, because a firm's learning curve experiences serve to more readily recognize a consumer's operational gap than their cognitive gap, incremental change through a firm's dynamic capability serves to



therefore better exploit a consumers' operational gap than their cognitive gap. Through refinements in a firm's resources configurations, a firm's dynamic capabilities serves to reduce the consumers' operational gap in which incremental refinements in a firm's current resources configurations, such as marketing, serves to develop products / services that alleviate the budget and geographical constraints of the consumer. Despite the increasing efficiency in the firm's use of resources, the path dependent reconfiguration of a firm's dynamic capability is, however, likely to increase core rigidity within the firm in its relationship with its consumers (Leonard-Barton, 1992; Levinthal & March, 1993; Levitt & March, 1988). Thus, because the path dependent function of a firm's dynamic capability promotes the exploitation of the consumer's operational gap, the consumer's cognitive gap is less likely to be exploited through the path dependent function of the dynamic capability.

*Proposition 4c: A firm's dynamic capability's path dependent function better exploits the consumers' operational gap than their cognitive gap.*

However, with respect to a firm-supplier interface, a firm's dynamic capability serves better in the exploitation of its suppliers' cognitive gap than the suppliers' operational gap. This is because the suppliers' output is utilized as resources for the firm's products / services. The path dependent function of the dynamic capability provides incremental change to the combinations of the firm's resources and the supplier's output. Thereby, the reconfiguration of the combinations through dynamic capability increase the likelihood to recognize and exploit the cognitive gap of the suppliers' output, the untapped uses of their output. Because the incremental change in

the resources configurations through the firm's dynamic capability refines the firm's knowledge about the use of the suppliers' output, the firm's demand to the suppliers is also refined. The suppliers' cognitive gap is exploited through the firm's refined demands. However, the exploitation of the suppliers' operational gap, such as improvement in the suppliers' productive capacity, is not directly sought through dynamic capability. The firm's refined demand through the path dependent function of the dynamic capability provides incentives or pressures for the suppliers to improve their productive capacity to meet the refined demand. This is a way the suppliers' operational gap is exploited through the firm's dynamic capability. Though a firm does not fully know the productive capacity of the suppliers due to its bounded rationality, the firm has an indirect influence on the suppliers' operational gap through its dynamic capability.

However, as a firm's external market becomes highly competitive the function of a firm's dynamic capability is changed. This is because a firm's dynamic capability is not only less vulnerable to path dependency but also basically changes its internal resources and capabilities in response to the changing conditions of its external market (Eisenhardt & Martin, 2000; Teece, 2007). Because the competition reduces the cognitive and operational gaps of the firm's stakeholders, the enhanced competition provides a high pressure on a firm to create new value opportunities by creating the cognitive and operational gaps for its stakeholders. The creation of cognitive and operational gaps for a firm's stakeholders is mainly achieved through fundamental reconfiguration of a firm's existing resources and capabilities by its dynamic capability. Hence, as a firm's external competition is increased its dynamic capability promotes

fundamental or significant changes in its resources configurations to create new cognitive and operational gap.

A firm's stakeholders' cognitive and operational gaps are increased or created through the path creating function of the dynamic capability. With respect to a firm-consumer interface, a firm seeks to create the consumers' cognitive and operational gaps through 'path creating' innovations by its dynamic capability. A firm's fundamental changes in its resources configurations through its dynamic capability create new combinations among resources and capabilities that lead to new innovations in products / services (Ng, 2007). The innovations that create or increase the consumers' cognitive gap also temporarily increase the operational gap of the consumers because the new products embedded with the innovations are usually expensive at beginning and thereby cause budget constraints to some consumers. With respect to a firm-supplier interface, a new use of a supplier's output is created by the fundamental change in combinations among the firm's input resources and the supplier's output through the firm's dynamic capability (Lavie, 2006; Nelson & Winter, 1982). The new created or discovered uses of the supplier's output are likely to create new demands on the supplier's output. However, because the new demands are not met instantaneously with the supplier's current productive capacity, the supplier's operational gap is also created or increased.

*Proposition 4d: The path creating function of a firm's dynamic capability creates cognitive and operational gaps of its stakeholders - consumers and suppliers.*

## DISCUSSION AND IMPLICATIONS

This study has several contributions to the resource based view (RBV), a recent dominant perspective in strategic management. The lack of attention to external causes as well as process of value creation has been central to criticisms to the RBV (Priem & Butler, 2001a). To address these shortcomings of RBV, this study examined the origins of a firm's value from cognitive and operational gaps of its stakeholders in its value chain as well as from its own internal gaps. The existence of such gaps creates an external dynamic that is motivated by competition and by the firm's IRM. Such a dynamic involves the recognition and exploitation of these gaps. Exploitation of these gaps, however, induces the creation of new cognitive and operational gaps by a firm's IRM. This firm-IRM and stakeholder gap interface underscores that value is a co-evolving and co-created process. This argument extended the RBV into more dynamic dimension of firm value. The dynamic dimension of firm value -its recognition, exploitation, and creation- was examined through a firm's internal resources mechanism (IRM).

Specifically, this study incorporated the concept of a firm's absorptive capacity and dynamic capability as key components of the firm's internal resources mechanism (IRM). This reflects more modern treatment of the RBV which have a distinctly dynamic orientation and provides greater attention to the internal processes of the firm. However, this approach to RBV through a firm's IRM - absorptive capacity and dynamic capability- is also consistent with the early motivation of the RBV. According to Penrose (1959) value stems from a process in which a firm's 'best use of resources' is

developed from “the way resources are accessed and used” (Moran & Ghoshal, 1999: 391). This study showed how the sources of value, i.e., cognitive gap and operational gap of stakeholder group, were recognized, exploited and even created through the functions of absorptive capacity and dynamic capability. Especially, due to the path dependency of a firm’s absorptive capacity, the consumers’ operational gap is better recognized and exploited than their cognitive gap. While, because a firm’s dynamic capability inherently provides change in its resources configuration and is also less vulnerable to path dependency, stakeholders’ cognitive and operational gaps are created through the firm’s dynamic capability.

However, this study’s approach to value is distinct to a traditional, i.e., neo-classical approach, such as in demand or production theory based approach. For instance, in demand theory, consumers’ utility or preference is assumed given or perfectly known to the consumers themselves. Thereby, the consumers choose a product / service that maximize their utility given their budget constraints. However, this study challenges the assumptions of the consumers’ perfect knowledge about their utility or preference. Due to limited cognitive ability or knowledge, the consumers’ preference is not fully known to the consumers but rather pioneered and shaped by a firm as argued by Carpenter and Nakamoto (1982). Similarly, because production theory of the neo-classical economics is based on perfect rationality, its production function that represents maximum output given inputs does not consider the producer’s limited cognitive ability. In those regards, the cognitive gap and operational gap approach to value may be more realistic than the traditional neo-classical economics because the stakeholders’ limited cognitive ability is

explicitly considered. Hence, the basic distinction of this study stems from different assumption on rationality of stakeholder groups.

Furthermore, a firm's external competition was also suggested as a significant determinant to the value process, i.e., changes in cognitive and operational gaps of the stakeholder group – consumer and supplier. Neo-classical economics traditionally viewed competition in terms of price of a firm's input and output. However, this study approached competition in terms of cognitive gap and operational gap. This approach is more general because the gaps involve more diverse dimensions of the firm's product and input resources beyond prices.

### **Implications for Managers of a Firm**

Due to bounded rationality, value is fundamentally related to changes in the cognitive gap and operational gap of stakeholders. This may provide significant managerial implications. First, managers should evaluate their firms' own cognitive gap and operational gap to recognize, exploit, and even create value. Because the recognition, exploitation and creation of value is contingent on the functions of absorptive capacity and dynamic capability, managers should understand path dependent and path creating aspects of absorptive capacity and dynamic capability. Because a firm's absorptive capacity is largely constrained by its past experiences, and dynamic capability is constrained by a firm's existing resource configuration, managers should be mindful that such path dependency leads to core rigidities to the firm (Leonard-Barton, 1992). Finally, managers should understand that the preferences of their consumers are changeable or

shapeable. Firms can shape the consumers' preferences through recognizing, exploiting, and even creating the cognitive gap and operational gap. In addition, managers should understand the dynamic value change process to provide a source of renewal to their firms when the firms are involved in levels of competition.

### **Implications for Future Research**

Currently this study introduces one critical limitation and as a consequence implication for future research. Operationalizing the cognitive gap and operational gap for empirical research is a big challenge because the true optimum and perceived optimum in the two constructs are not easy to measure in a real world. However, alternatively historical data such as time series or panel data which consist of various cross-section units' time series data can give some proxy for the two concepts. For example, because it is likely that consumers' untapped or un established need is embedded in their long term optimum, the cognitive gap of the consumers can be constructed through the difference between the long term optimum and short term optimum. The operational gap can be constructed through the difference between the short term optimum and consumers' current capacity. However, because each individual consumer' perceived optimum is different depending on the individuals, individual effect should be considered in the constructs of short term optimum as in longitudinal data analysis with fixed effect to consider unobservable individual effect (Baltagi, 2001; Hsiao, 1986). Future research can contribute through the operationalization of the cognitive gap and operational gap and through testing the propositions suggested in this study.

# **CHAPTER III**

## **THE DETERMINANTS OF STRATEGIC ALLIANCE FORMATION IN BIOTECHNOLOGY SECTOR**

### **INTRODUCTION**

Strategic alliances that involve voluntary agreements between firms to exchange, share, and co-develop products, technologies, or services have become an increasingly important subject of research inquiry among management researchers (Gulati, 1998). A large body of theoretical and empirical research finds strategic alliances provide benefits such as the acquisition of complementary resources, reduction of transaction costs, enhancement of a firm's competitive position, increases in market power, and a reduction of risk in highly competitive markets (Barringer & Harrison, 2000; Brass, Galaskiewicz, Greve, & Tsai, 2004; Gulati, 1998; Ireland, Hitt, & Vaidyanath, 2002; Kogut 1988; Lavie, 2006; Moller & Svahn, 2006; Young-Ybarra & Wiersema, 1999). Yet although various empirical research have examined the performance implications of alliances (e.g. Ireland et al, 2002 for a review), with the possible exception of Alliance Management Capability explanations, there have been relatively limited attention given to the study of the causal determinants of alliance formation.

A basic premise of the concept of AMC is that firms with experiences in managing alliances are better positioned to leverage their past experiences in managing future alliances and thus suggests a firm's AMC positively influences a firm's formation of alliances. Various studies have confirmed this explanation in which Kale, Dyer, and



Singh (2002) found that firms that possess an ‘alliance management capability (AMC)’ were more likely to form alliances and can result in a higher level of success.

Specifically, Dyer, Kale and Singh (2001) shows that firms, such as Hewlett Packard, Eli Lilly and Oracle who developed a dedicated unit to the management of alliances – which promotes the development of experiences in managing multiple alliances- were able to achieve a 25% higher success rate than firms without this capability. Hence, as AMC improves a firm’s success with alliances, this suggests AMC positively influences the formation of alliances. Although such an AMC explanation offers positive developments in explaining the determinants of alliance formation, such an explanation faces three limitations.

First, since AMC is based on a firm’s experiences in managing alliances, the number of alliances managed by the firm should be strongly correlated with this concept of AMC. Hence, in accordance to a logic of AMC, increases in the number of prior alliances formed should positively influence future alliances. Yet, empirical research finds that increasing the number of prior alliances eventually lead to diminishing return effects and thus suggesting limits to the formation of a firm’s alliances (Deeds & Hill, 1996; Rothaermel & Deeds, 2006). For instance, in Rothaermel and Deeds’ (2006) study of the biotechnology industry, they argue executives face increasing limits in their ability to manage multiple alliances because of limits associated with bounded rationality. As managers deal with a greater number of alliances, the complexity involved in managing such interdependencies exceeds the management’s cognitive ability to affect a successful outcome. Furthermore, and on a related note, bounded rationality can yield agency and

governance related problems that preclude a successful alignment of the various interests of a firm's alliance partners. Thus, due to limits imposed by bounded rationality, increase in alliances formation leads to increasing agency and governance costs which can lead to diminishing return effects. Furthermore, Rothaermel and Deeds (2006) also argue the marginal benefit of forming an alliance is greater than the marginal benefits of subsequent alliances because the gains associated with the former are more readily obtained than the latter. In other words, managers tend to seek the "low hanging fruit" of alliances in which subsequent alliances tend to yield a diminishing return effect.

These arguments are consistent with Rothaermel and Deeds' (2006) empirical finding in which they observed a firm's performance exhibits a diminishing return effect or inverted U shape effect with its number of alliances. One implication of this diminishing effect to the formation of firm alliances is it suggests that firms are more likely to form an alliance when the number of prior alliances falls below this point of diminishing returns. Conversely, firms are less likely to form an alliance or even reduce the formation of alliances when they exceed this point of diminishing returns. This suggests that although a firm's AMC is strongly correlated with a firm's cumulative alliances, AMC explanations, however, do not account for the role of such diminishing return effects on a firm's alliance formation.

Second, since firms form alliances to gain access to new external experiences (Lane & Lubatkin, 1998), a firm's AMC does not account for "absorptive capacity" explanations. A basic argument underlying absorptive capacity explanations is that a firm's prior experience reduces the cost of assimilating external experiences because by

increasing a firm's prior experiences it increases its ability to relate to external experiences. Hence, despite sharing a common emphasis on a firm's prior knowledge, absorptive capacity reasoning is different from alliance management capability explanations. With AMC, prior experiences are drawn upon to reduce the cost of managing future alliances through developing governance structure and routines (Kale, Dyer, & Singh, 2002). While, the prior experiences in absorptive capacity serve the purpose of assimilating external knowledge experience so as to commercialize new products (Lane & Lubatkin, 1998). As a result, the formation of alliances are, therefore, not only dependent on a firm's ability to govern future alliances –as would be argued by an AMC perspective, but also on a firm's ability to assimilate external knowledge and commercialize new product developments.

Third, as AMC focuses on a firm's experiences in managing multiple alliances, AMC tends to understate the competitive conditions that surround the formation of alliances (Eisenhardt & Schoonhoven, 1996). As competition promotes changes in product and strategic factor (input) markets (Barney, 1986; Porter, 1980), firms respond to such competition by developing new sources of competitive advantage (Besanko, Dranove, Shanley, & Schaefer, 2003). Competition can thereby promote the formation of alliances because by gaining access to new resources and experiences, firms can develop new sources of competitive advantage (e.g., Eisenhardt & Schoonhoven, 1996; Park, Chen, & Gallagher, 2002; Patzelt, Shepherd, Deeds, & Bradley, 2008; Shan, 1990). Namely, as competition promotes incentives to reduce costs and /or promote Schumpeterian like innovations, competition could positively influence the formation of

specific types of alliances. For instance, as competition promotes a greater focus on cost reduction, competition can promote “exploitive” alliances that focus on encouraging existing strengths by developing partnership that reduces a firm’s operating efficiencies and costs. Competition can also promote “explorative” alliances that promote coordination of diverse partnerships to which promote innovation (e.g. Nicholls-Nixon & Woo, 2003; Rothaermel & Deeds, 2004; Shan, Walker, & Kogut, 1994). Hence, as AMC focuses on the firm’s cumulative alliance experiences, AMC explanations not only fail to consider such external conditions, but also the effects of competition on the formation of these specific types of alliances are underdeveloped.

As a result, although the performance consequence of alliance has been well examined subject of research inquiry, the determinant of alliance formation remains a subject of less attention, especially in regards to the formation of exploitive and explorative alliances. Hence, the objective of this study is to further advance understanding of the determinant of alliance formation by augmenting AMC explanations with those of absorptive capacity, and competition so as to develop a theoretical model to explain not only the formation of alliances, but also the formation of exploitive and explorative alliances. This theoretical model is empirically tested using fixed effects estimation on panel data of 97 firms in the pharmaceutical industry over 1999 to 2004. This industry was chosen because it represents a knowledge-oriented economy in which a firm’s internal learning and competition have been found to influence the formation of a firm’s alliance (Das & Teng, 2000, 2002; Eisenhardt & Schoonhoven, 1996; Hamel, 1991; Holmqvist, 2004; Khanna, Gulati, & Nohria, 1998;

Koza & Lewin, 1998; Larsson, Bengtsson, Henriksson, & Sparks, 1998; Powell, Koput, & Smith-Doerr, 1996).

In organizing this study, this study's unit of analysis, definitions and assumptions are first stated. This study's conceptual developments follow in which the determinants of alliance formation – AMC, absorptive capacity, competition – on the formation of a firm's alliances- including exploitation and exploration- are discussed next. Testable hypotheses are also developed. The next section provides a discussion of the data and a panel estimation method using generalized method of moment (GMM). A discussion of the results follows. Lastly, the study's conclusions, implications and contribution to alliance research are examined.

## **CONCEPTUAL FOUNDATIONS**

### **Unit of Analysis and Definitions**

Since the focus of this study is on explaining determinants that impact the formation of a firm's alliance, this study's unit of analysis is based on the firm level. In defining an alliance, this study follows Gulati's definition of strategic alliance as "voluntary agreements between firms involving exchange, sharing, and codevelopment of products, technologies, or services" (1998: 293). However, as alliances have been found to be heterogeneous in form and in function (Rothaermel & Deeds, 2006; Ng, Unterschultz, & Laate, 2006), this study differentiates strategic alliances into two types of alliances; explorative alliance and exploitive alliance. Conceptually, explorative

alliance is an alliance that involves an “explore[ation of] new opportunities” while the exploitive alliance is an alliance to “exploit [an] existing capability” (Koza & Lewin, 1998: 256). Specifically in the context of the pharmaceutical industry, the alliances “focused on basic research, drug discovery and development” have been characterized as *explorative alliance* while the alliances targeting “commercialization (clinical trials, FDA regulatory process, and marketing and sales)” reflect *exploitive alliance* (Rothaermel & Deeds, 2004:209-210).

### **Assumptions**

In developing this study’s conceptual model, we assume that each individual firm or its managers of strategic alliances are boundedly rational (Simon, 1982). Unlike the perfectly rational economic man of neo-classical economics, individual agents are boundedly rational because there are not only basic limits in the agent’s knowledge, but also cognitive limits in their ability to process information (Simon, 1982). This is an implicit assumption upon which AMC explanation stands because according to the logic of AMC, limits in cognitive ability and knowledge in managing alliances are improved by experience. Similarly, arguments related to the key factors, such as absorptive capacity, are also directly related to the assumption of bounded rationality. For instance, absorptive capacity is related to ‘learning’ such as assimilation of external knowledge in which learning is a concept that can not be compatible with perfect rationality assumption (Hayek, 1945). In addition, since the pharmaceutical industry is extremely complex industry, it is difficult to impose economic perfect rationality assumption in the

development of this study's model. Therefore, bounded rationality is most basic and implicit assumption of this study.

## **THEORY DEVELOPMENT AND HYPOTHESES**

### **Alliance Management Capability (AMC) and Alliance Formation**

The alliance management capability entails a complex set of coordinating tasks that involve decisions about ‘alliance scope, alliance partner selection, and governance structure’ (Ireland et al., 2002). A specific emphasis of AMC is its attention to governance structures, coordination mechanism, and routines used in managing alliances (De Man, 2005; Draulans, deMan, & Volberda, 2003; Heimeriks, Klijn, & Reuer, 2009; Kale et al., 2002; Rothaermel & Deeds, 2006). A basic argument underlying a firm’s AMC is that a firm’s past experiences in management alliance serves to develop routines that promote the governance and coordination of future alliances. Firms develop a greater capability in governing and coordinating alliances if they have more alliance experience because inferences or insights from the past experiences are embodied in routines (Nelson & Winter, 1982) and routines facilitate the governing and coordinating current and future alliances (Hoang & Rothaermel, 2005; Kale et al., 2002; Zollo, Reuer, & Singh, 2002). Therefore, a firm with greater alliances experiences yields an AMC that promotes the formation of future alliances, because this prior experience reduces the governance cost of managing multiple alliances (Hoang & Rothaermel, 2005; Ireland et al., 2002; Kale et al., 2002). This was empirically supported by the finding that firms

learn to better govern and coordinate alliances as experience accumulates (Anand & Khanna, 2000; Rothaermel & Deeds, 2006). Because a firm's alliance experiences are strongly correlated with a firm's cumulative alliances (Anand & Khanna, 2000; Hoang & Rothaermel, 2005; Kale et al., 2002; Rothaermel & Deeds, 2004; Zollo et al., 2002), AMC explanations suggest there should be a positive relationship between a firm's cumulative alliances and the formation of new alliances.

### **Diminishing Effects of Alliance Experiences**

However, other studies have suggested a firm's formation of alliances is not a strictly positive function of a firm's AMC – cumulative alliance experiences. Bounded rationality yields information processing constraints that limit the number of alliances that can be formed by a firm's management. As the number of alliances increases, managers face increasing challenges in governing and monitoring the behavior of their alliance partners towards a common objective. For instance, these difficulties are heightened when partners are opportunistic to which increases the cost of monitoring strategic partners and thus reducing incentives to form alliances (Das & Teng, 1996, 2000; Inkpen, 2001; Ireland et al., 2002). Moreover, with increases in alliances experiences, bounded rationality can lead to myopic views that restrict managers to focus on exploiting synergies of past partnerships and thus preclude the exploration of synergies among new partners. These considerations suggest alliances experience – as reflected by the cumulative alliances - can yield diminishing returns and has been



empirically supported by the pharmaceutical studies of Deeds and Hill (1996) and Rothaermel and Deeds (2006).

One basic implication of this diminishing return effect finding is that such diminishing effects suggest that a firm's decision to form an alliance may be dependent on the relationship between a firm's cumulative alliances experiences and that of this point of diminishing returns. Specifically, in terms of new product development, Deeds and Hill (1996) and Rothaermel and Deeds (2006) regarded this point of diminishing return as a form of an 'optimum' AMC because it reflects "a firm's maximum ability to manage alliances effectively" (Rothaermel & Deeds, 2006: 433). Deviations from this point of diminishing return may impact a firm's propensity to form an alliance (Patzelt et al., 2008; Rothaermel & Deeds, 2006). When a firm's cumulative alliance experiences or current AMC falls below this point of diminishing return – termed as a low relative AMC – the increase in alliance experiences through the formation of new alliance will thus increase a firm's performance. Deviations below from this point of optimal returns should thus favor the greater formation of alliances. However, due to the diminishing return effect, the rate of increase in alliance formation increases at a decreasing rate. Consequently, as a firm accumulates excessive alliance experiences (i.e. greater number of past alliances) beyond this point of diminishing returns – termed as a high relative AMC-, the firm is likely to reduce the number of future alliances. This is because much of the alliance benefits have been exploited by earlier alliance formation. Namely, beyond this point of diminishing return, benefits of alliances, such as synergies, have been much exploited by prior alliance relationships. Furthermore, increasing alliances

leads to increasing governance cost to which contributes to such diminishing returns. As a result, this study proposes that relative to the point of diminishing returns, there is a positive relationship between AMC and alliance formation when a firm's AMC is located below the point of diminishing return, i.e., low relative AMC. While, negative relationship between AMC and alliance formation occurs when a firm's AMC is located above the point of diminishing return, i.e., high relative AMC. These arguments are reflected by the following proposition.

*Hypothesis 1a: Relative to the point of diminishing returns, a firm's AMC has an inverted U-shaped relationship to a firm's alliance formation.*

### **Different Types of Alliance and Diminishing Effects of Alliances Experiences**

However, as alliances are formed to achieve specific cost related objectives as well as innovation related objectives, firms have been found to be involved in the formation of exploitive and explorative alliances (Koza & Lewin, 1998; Lavie & Rosenkopf, 2006; Park et al., 2002; Rothaermel & Deeds, 2004, 2006). The distinction between exploitation and exploration was recognized earlier by March (1991) who defines:

“The essence of exploitation is the refinement and extension of existing competencies, technologies and paradigms...The essence of exploration is experimentation with new alternatives” (1991: 85).

Most notably, exploitation and exploration are distinct search activities that have been commonly viewed as “competing trade-offs” (Levinthal & March, 1993; March, 1991;

Gupta, Smith, & Shalley, 2006). Such trade-offs stem from the “principle of learning substitution” in which “fast adaptation at one level in an organization leads to slow adaptation at others” (Levinthal & March, 1993: 101). For instance, although a goal of exploitation ultimately yields improvements in a firm’s efficiencies, such efficiency gains are made at the expense of a firm’s goals to explore. This is because exploration emphasizes experimentation rather than a refinement of activities (e.g. March, 1991). Moreover, another distinction between exploitation and exploration is that since exploitation favors the leveraging of established experiences, exploitation tends to yield returns that are more immediate and less uncertain than exploration. Researchers have subsequently extended such concepts of exploitation and exploration to the study of alliances (e.g. Rothaermel & Deeds, 2004; Ng et al., 2006). Exploration and exploitation alliances serve, respectively, the functions of ‘exploring new opportunities’ and ‘exploit the existing capabilities’ of partnered firms (Koza & Lewin, 1998: 256).

Since there are diminishing effects to alliance formation, this study thus argues that when a firm exhibits a relatively low AMC, firms prefer the formation of ‘exploitive’ alliances over that of ‘explorative’ alliances. This is because since exploitation builds upon established experiences, the formation of exploitive alliance is favored over exploration because it serves to leverage a common body of experiences. Furthermore, because the returns to explorative alliance are more uncertain due to their more costly experimentations, especially in pharmaceutical industry (Koza & Lewin, 1998; Rothaermel & Deeds, 2004), firm will thus favor the more immediate and less

uncertain returns of exploitive alliance. This is because returns from exploitation involve refinements to a firm's established experiences.

When a firm exhibits a high relative AMC, the firm favors the reduction of exploitive alliance over that of explorative alliances. Under conditions of a high relative AMC, firms by definition of the diminishing return effect face declining returns to their alliance efforts. Under such declining conditions, firms are more likely to be risk takers as implied by prospect theory. Namely, according to prospect theory, a firm becomes a risk seeker when its returns fall below a particular reference point, such as a firm's past performance. While, conversely the firm becomes a risk averter when its returns falls above this reference point (e.g. Fiegenbaum & Thomas, 1988; Lehner, 2000; Kahneman & Tversky, 1979). Hence, in drawing on such arguments, this study argues that a firm's point of diminishing returns can serve as a reference point to which influences a firm's risk preferences in the formation of its alliance. Namely, due to the diminishing return effect, firm with a high relative AMC – above the point of diminishing returns - should favor greater risk taking. As exploration is generally a more risky activity than exploitation, such risk taking therefore involves the greater formation of explorative alliances than exploitive alliances. Furthermore, due to the highly risky returns as well as costs associated with exploration, exploration yield below average returns. As a result, as a firm accumulates alliances, beyond the point of diminishing returns, not only favors the greater risks of explorative alliances, but their below average returns yields a reduction in performance that is consistent with the diminishing return effect. This

reduction in performance that is associated with exploration thereby gives rise to the diminishing effects observed by Rothaermel and Deeds (2006).

*Hypothesis 1b: A relatively low AMC favors formation of exploitive alliances over that of explorative alliances.*

*Hypothesis 1c: A relatively high AMC favors formation of explorative alliances over that of exploitive alliances.*

### **Absorptive Capacity**

Absent in AMC explanations is that the formation of an alliance is also dependent on a firm's ability to learn from the experiences of its alliance partners. By accumulating experiences, a firm learns to relate to new and external sources of information and thus such learning enables the firm to form future alliances (Das & Teng, 2000; Eisenhardt & Schoonhoven, 1996; Hamel, 1991; Holmqvist, 2004; Khanna et al., 1998; Lane & Lubatkin, 1998; Larsson et al., 1998; Powell et al., 1996; Rothaermel & Deeds, 2006; Zhang, Baden-Fuller, & Mangematin, 2007). Such learning has been depicted by the concept of 'absorptive capacity'. Absorptive capacity is defined as a firm's ability to "evaluate, assimilate, and commercially apply new external knowledge" (Cohen & Levinthal, 1989, 1990). A basic argument of absorptive capacity research is that a firm's absorptive capacity is positively influenced by a firm's accumulated experiences. A firm's accumulated experiences are instrumental to the assimilation of new external information because prior knowledge facilitates a firm's ability to relate to external information (Cohen & Levinthal, 1989, 1990). For instance,

Cohen and Levinthal (1989, 1990) empirically showed that the effect of basic science on R&D spending (i.e. investment in absorptive capacity) positively influences the assimilation of new external knowledge.

More recently, the concept of absorptive capacity has been extended to explaining the formation of a firm's alliances (Lane & Lubatkin, 1998; Powell et al., 1996). In particular, as new product / services, especially in the pharmaceutical industry, are the products of multiple technologies (i.e. Research and Commercializing technologies) that are not held by any one firm (Powell et al., 1996), a firm's absorptive capacity should thus be instrumental in assimilating these technologies. As a result, a firm's absorptive capacity should positively influence their formation of alliances. This is consistent with prior studies that have found a positive relationship between a firm's cumulative experience and alliance performance (Nicholls-Nixon & Woo, 2003; Tsai, 2001; Van den Bosch, Volberda, & De Boer, 1999; Zollo et al., 2002). For instance, Nicholls-Nixon and Woo's (2003) empirical findings indicate that a firm's R&D promotes strategic alliances to improve its technical outputs such as pharmaceutical patents and new biotechnology products.

*Hypothesis 2a: Absorptive capacity promotes alliance formations.*

Although prior research has found absorptive capacity can promote alliances (e.g. Lane & Lubatkin, 1998), the effect of a firm's absorptive capacity on the formation of exploitation or exploration alliances have not been examined (see Rothaermel & Deeds, 2004). This study argues that since exploitive alliances exploit a firm's current capability and promote commercialization (Koza & Lewin, 1998; Rothaermel & Deeds, 2004), a

firm's absorptive capacity which is oriented to the commercialization of products and service should thus favor the formation of exploitive alliances. Furthermore, because absorptive capacity is a highly path dependent process that builds upon past experiences, such path dependency reinforces assimilation of experiences found in exploitive alliance. Thus, absorptive capacity should positively influence exploitive alliance formation. However, since increase in exploitation leads to reduction in exploration due to the "knowledge substitution effect," absorptive capacity should thereby reduce incentives to form explorative alliances. In other words, due to the trade-off between exploitation and exploration, a firm's absorptive capacity in developing exploitive alliance will drive out the efforts to form explorative alliances (Lavie & Rosenkopf, 2006; March, 1991). Hence, increases in the formation of exploitive alliances will lead to reduced formations of explorative alliances.

*Hypothesis 2b: A firm's absorptive capacity has a greater effect on the formation of exploitive alliances than that of explorative alliances.*

## **Competition**

The formation of a firm's alliances is also influenced by the competitive conditions of the market (e.g. Dickson & Weaver, 1997; Koza & Lewin, 1998; Park et al., 2002; Park & Zhou, 2005; Patzelt et al., 2008; Silverman & Baum, 2002). Prior research argued that alliances not only enable a firm to withstand competition, but also to impose stronger competition on its rivals because a firm can become better positioned through alliances by denying rivals access to resources (Gomes-Casseres, 1994; Gulati,

1995; Park & Zhou, 2005; Silverman & Baum, 2002; Walker, Kogut, & Shan, 1997).

Thus competition promotes further alliance formation.

*Hypothesis 3a: Competition promotes alliance formation.*

However, the effects of competition on the formation of specific types of alliances have not been researched (e.g. Dickson & Weaver, 1997; Koza & Lewin, 1998; Park et al., 2002; Park & Zhou, 2005; Patzelt et al., 2008; Silverman & Baum, 2002). As competition promotes imitative processes, there are increasing pressures for firms to differentiate through the innovation of products and services (e.g. Schumpeter, 1934; Deephouse, 1999; Voss, Sirdeshmukh, & Voss, 2008). For instance, in Deephouse's (1999) study of the banking industry, he found increasing competition promote increasing efforts to differentiate. This study argues with increasing competition, pressures to differentiate favor the formation of explorative alliances because explorative alliances expose the firm to new technological developments that are necessary to developing innovative products. Hence, competition promotes the formation of explorative alliances because access to new technologies not only develops new innovations, but as a consequence differentiates a firm's products from its competitor's offerings. However, due to the trade-off between the exploration and exploitation, increases in explorative alliances from increasing competition will lead to a decrease in exploitive alliance formation.

*Hypothesis 3b: Competition promotes formation of explorative alliances more than exploitive alliances.*



## METHODS

### Data and Sample

To examine factors (relative levels of AMC, absorptive capacity, competition) impacting the formation of a firm's alliances – including exploitive alliance and explorative alliance, this study's hypotheses are empirically tested in the pharmaceutical industry because strategic alliances have been extensively reported in the pharmaceutical industry (e.g. Deeds & Hill, 1996; Powell et al., 1996; Rothaermel & Deeds, 2004, 2006). To examine this study's hypotheses, alliance data was drawn from Bioscan (American Health). Bioscan has been used in various pharmaceutical studies (e.g. Deeds & Hill, 1996; Powell et al., 1996; Rothaermel & Deeds, 2004; Shan et al., 1994). To develop the absorptive capacity measure, financial data from the COMPUSTAT database of Standard and Poor (e.g. Hitt, Hoskisson, Johnson, & Moesel, 1996), and Mergent Online were used. Competition was constructed from the patent database of United States Patent and Trademark Office (USPTO) (e.g. Ahuja, 2000; McGrath & Nerkar, 2004; Rothaermel & Deeds, 2004; Zhang et al, 2007).

From these data sources, a panel data set of public pharmaceutical firms was constructed with 6 years of data from 1999 to 2004<sup>2</sup>. Over this sample period, 326 bio and pharmaceutical firms were identified in the Bioscan data base. However, since the focus is only on pharmaceutical firms, 105 of the 326 firms with standard industrial classification (SIC) code of 2834 (*'pharmaceutical preparations'* (Rothaermel, 2001))

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<sup>2</sup> Because the date of the Bioscan data used in the study was not the end of December a given year, we used the 2005 Bioscan data to fully include a firm's activities such as alliance formation of year 2004. The dependent variable of the current study is a longitudinal data from 2000 to 2004.

were used in this study's sample. This subsample (SIC 2834) has been used in various empirical studies (e.g., Markman, Espina, & Phan, 2004; Rothaermel, 2001).

Furthermore, this sample was chosen because all firms in this subsector involve the development of drugs that are subject to FDA regulations. With this restricted sample, 8 firms were also removed because of missing alliance data. This resulted in a panel / longitudinal data set of 97 firms over the period of 1999 to 2004.

The panel data set is advantageous for empirical research of this type because it increases the degrees of freedom and reduces the collinearity among explanatory variables and thereby improving the efficiency of econometric estimates (Hsiao, 1986). In addition, longitudinal / panel data estimations, such as 'fixed effect estimations', can account for unobserved heterogeneity in statistical analysis (Cameron, 1998). Since our unit of analysis is focused on the firm level, we would expect that given our constructs of relative AMC, and absorptive capacity, a high degree of unobserved heterogeneity is expected between firms in the sample.

## **Dependent Variables**

**Total alliance, explorative alliance and exploitive alliance.** To measure alliance formation, total alliance variable is used. This variable is constructed by counting all agreements a firm has been involved in which includes the summation of the number of R&D, drug discovery, sales and marketing agreements found in Bioscan database (Rothaermel & Deeds, 2004). In drawing on previous empirical measures, explorative alliance is a count measure of the sum of the following types of agreements

found in Bioscan: basic research, drug discovery and development. These alliances types have been extensively used by various researchers (e.g. Park et al., 2002; Powell et al., 1996; Rothaermel & Deeds, 2004). While, exploitive alliances is a count measure of the sum of commercializing agreements that consists of clinical trials, FDA regulatory process, and marketing and sales (Rothaermel & Deeds, 2004: 209-210) and has been used by various alliance researchers (e.g., Deeds & Hill, 1996; Powell et al., 1996; Rothaermel & Deeds, 2004; Shan et al., 1994).

### **Explanatory Variables**

**Relative alliance mangement capability (RAMC).** Since RAMC is relative to a point of diminishing returns, RAMC is constructed as the difference between a firm's current AMC as measured by its cumulative alliance and the optimal AMC. Specifically, as a firm's AMC reflect its cumulative experiences with alliances, and alliance experience has been usually measured by cumulative number of alliance in prior research (Anand & Khanna, 2000; Hoang & Rothaermel, 2005; Kale et al., 2002; Rothaermel & Deeds, 2004; Zollo et al., 2002), this study defines AMC through the total number of alliances formed by the firm<sup>3</sup>. The optimal AMC refers to the point of diminishing returns. It is computed through a nonlinear panel regression<sup>4</sup>, as in equation 1, of a count variable of a firm's number of products developed on AMC and its squared

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<sup>3</sup> More exactly speaking, the AMC is one year lagged variable of total alliance. So even when total alliance is used as dependent variable, RAMC is used as right hand variable because it is made based on one year lagged variable of total alliance.

<sup>4</sup> The nonlinear regression is nonlinear in terms of 'variables'. However, in econometrics, the term, 'nonlinear regression', is usually used in terms of coefficient estimated (Gujarati, 2002).

term with controls, such as a firm's size, age, innovativeness and diversity of which definitions are provided in control variable sections. This panel estimation using fixed effects is shown by the following equation

$$\text{Equation 1: } NPD_{it+1} = b_0 + b_1 * AMC_{it} + b_2 * AMC_{it}^2 + B * \text{Control variables}_{it} + V_{it},$$

where NPD is new products developed at  $t+1$  period, AMC is total alliance at  $t$  period and  $B$  is coefficients of control variables, and  $V_{it} = a_i + U_{it}$ , in which  $a_i$  is fixed effect component of error term,  $V_{it}$ ,  $i = 1, 2, 3 \dots 97$ ,  $t = 1, 2 \dots 5$ .

With this estimation, the point of diminishing returns can thus be computed mathematically by solving the estimated function with respect to 'AMC' and setting this estimated equation to 0 (See also Rothaermel & Deeds, 2006). As a result, this computed value of the point of diminishing returns is 22 -as an integer number<sup>5</sup> - in which a firm with 22 alliances maximizes its development of new products. Given this point, the RAMC is thus constructed as the difference in total alliance from this point of diminishing return. To interpret, RAMC, it takes a negative and positive value that respectively indicates a low and high relative AMC. However, for the low relative AMC, we use its absolute value to indicate size of RAMC, i.e. how far below a firm's current AMC is located from the optimal AMC. Thereby the reduction in a firm's RAMC regardless of being high or low indicates that the firm approaches to the optimum AMC. To capture points above and below the point of diminishing return, the variables *RAMC\_above* and *RAMC\_below* were created to respectively reflect high and low

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<sup>5</sup> The solved value was 21.93 and it was rounded up to nearest integer number, 22 because the AMC is a count number of alliance.

RAMC.

**Absorptive capacity.** Although there are other proposed measures of absorptive capacity (e.g. Zahra & George, 2002; Ng, 2007), a commonly used measure of absorptive capacity is the R&D intensity (e.g., Cohen & Levinthal, 1990; Mowery, Oxley, & Silverman, 1996; Lane & Koka, 2006; Tsai, 2001). R&D intensity is measured by the ratio of R&D expenditures to sales. The financial data was from the Compustat database of Standard and Poor (e.g. Hitt et al., 1996), and Mergent Online.

**Competition.** Unlike more traditional depictions of competition – as measured by the number of similar and competing firms, competition is defined as rivalry among firms with similar technologies (e.g. Henderson & Cockburn, 1994; McGrath & Nerkar, 2004). This study draws on this distinction of competition because competition in a knowledge based industry such as pharmaceutical industry is not based similarity of firms but rather similarity in technologies. Patent data were used as a basis for construction of this study's measure of competition in which innovations represented by patents are targets for competition. To develop such a measure of competition, the patent database of United States Patent and Trademark Office (USPTO) was used. The USPTO patent database has its own classification system with class and subclass codes. For example, a typically classification has the following structures in with a classification of "482/1" indicates that the first number, 482, represents the class of invention. The number following the slash is the subclass of invention within the class. There are about 450 classes of invention and about 150,000 subclasses of invention..." (USPTO website, <http://www.uspto.gov/go/classification/help.htm#3>). As shown in appendix 2,

competition for any given year and firm, is calculated by the following steps. First, for a certain patent with class/subclass in a firm for a given year, we count all patents in the USPTO database which have the same class and subclass with the patent in the firm for the given year. Second, we count patents with same class/subclass within the firm (i.e., to check or count how many patents with same class/subclass within the firm). Third, we subtract the firm's patent count –consisting of both the technical class and subclass– from the whole USPTO database count for the patent being held by the focal firm. This difference is used to measure the extent of technological competition faced by the firm for the patent with a class/subclass. Third, we repeat the first to third processes for all different class/subclass patents within the firm. Finally we take the average over the class/subclass to derive a measure of a firm's competition. This can be expressed through a following formula.

$$\text{Competition of a firm}_i = \frac{1}{N} \sum_{j=1}^N [A_j - a_{ij}]$$

where  $N$  is the number of unique patents (i.e. distinct with class/subclass) within a firm <sub>$i$</sub> ,

$$A_j = \sum_{i=1}^T a_{ij}, \quad T = \text{total number of firms in USPTO}, \quad a_{ij} = \text{total number of same patent}_j$$

within a firm <sub>$i$</sub> , and patent <sub>$j$</sub>  is a patent with a distinct class and subclass combination.

### Control Variables

Common controls used in pharmaceutical studies consist of variables such as a firm's size, age, innovativeness and technical diversity. The firm size is measured by the number of employees (e.g. Powell et al., 1996; Rothaermel & Deeds, 2004, 2006; Shan

et al., 1994), while a firm age was measured based on its founding year (Powell et al., 1996; Rothaermel & Deeds, 2004, 2006; Silverman & Baum, 2002). A firm's innovativeness was measured by a count variable of the firm's most recent 5 years of cumulative patents (e.g., patents of 1995, 1996, 1997, 1998, and 1999 are summed for innovativeness of year 1999, the sum of patents from 1996 to 2000 is innovativeness of year 2000, etc) which is consistent with prior research (Ahuja, 2000; Rothaermel & Deeds, 2004, 2006; Stuart & Podolny, 1996; Silverman & Baum, 2002). A firm's technical diversity was measured by counting the distinct classes in which a firm's patents are categorized. This is also consistent with previous research (Rothaermel & Deeds, 2004, 2006; Shan et al., 1994; Silverman & Baum, 2002).

### **Model Specification and Estimation**

Our data set is a panel data which consist of 6 years of 97 cross-sectional units. Because the 97 pharmaceutical firms may have their own unique characteristics, such as unique resources and capabilities, which are not easily observable (Barney, 1991) but can have a statistically significant effect (Powell et al., 1996), panel analysis especially with fixed effect estimation is appropriate (Baltagi, 2001; Hsiao, 1986; Powell et al., 1996). Specifically, we use fixed effect estimation of this panel data because random effect estimation is based on an assumption that individual effects are uncorrelated with the explanatory variables, i.e. if unobserved effects are correlated with the explanatory variables, the random effects estimators are inconsistent (Baltagi, 2001; Cameron, 1998; Mundlak, 1978). In this study, the key explanatory variables such as alliance

management capability and absorptive capacity are influenced by a firm's past experiences and each firm's experiences are not likely to be same among the (sample) firms. As a result, a firm's unique unobservable aspects of experiences are likely to be influenced by these key explanatory variables<sup>6</sup>. In that regards, the fixed effect model is preferred because the assumption about the exogeneity of explanatory variables to the unobservable aspects is more strictly required in the random effect model than in the fixed effect model.

With the fixed effect estimation, this study's hypotheses were tested through a three step processes. First, for the 6 year panel data set, we examine the effects of a firm's relative AMC (RAMC), absorptive capacity, and competition on total alliance formation. Equation 2 is estimated using a generalized method of moment (GMM) procedure that accounts for fixed effects. In this model, we consider a one year time lag between a dependent variable and right hand side variables because the formation of alliances is not instantaneous as recommended in prior research (e.g., Powell et al., 1996). The equation 2 is as follows.

$$\text{Equation 2: Total alliances}_{t+1} = \eta_0 + \eta_1 * \text{RAMC\_below}_t + \eta_2 * \text{RAMC\_above}_t + \eta_3 * \text{Absorptive capacity}_t + \eta_4 * \text{Competition}_t + \Theta * \text{Control variables}_t + \Phi_{it},$$

where  $\Phi_{it} = \varphi_i + \Omega_{it}$ ,  $\varphi_i$  is a heterogeneous firm's fixed effect component of error term  $\Phi_{it}$ ,  $i = 1, 2, 3 \dots 97$ ,  $t = 1, 2 \dots 5$ ,  $\Theta$  is coefficients of control variables.

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<sup>6</sup> We also tested for the fixed effect by performing F-test of the joint significance of the fixed dummies, i.e.  $H_0 = \alpha_1 = \alpha_2 = \alpha_3 = \dots = \alpha_{96} = \alpha_{97}$  as recommended in Baltagi (2001) and Hsiao (1986) with result that the hypothesis was significantly rejected at significance level of 1%, i.e. there was fixed effect significantly in our model.



An advantage of GMM procedure is it does not require any exact distribution assumptions on the disturbance terms of a model. While, for example, maximum likelihood estimation (MLE), one of the more popular estimators, requires an assumption about a specific distribution of an estimated model, such as a normal distribution. Hence, GMM is a more robust estimation method. In addition, many common estimators such as OLS, IV, 2SLS and even MLE are special cases of GMM (Hamilton, 1994). GMM has also been recommended for panel estimation that involves count data (Cameron, 1998). GMM estimation is based on the assumption of ‘orthogonality conditions’ that the disturbances in the equations are not correlated with instrumental variables (Hansen, 1982). Because researchers usually use the lagged variables of explanatory variables including constant term (e.g. Hansen & Singleton, 1982), this study also followed this procedure<sup>7</sup>. However, when the number of instrumental variables is greater than the number of coefficients estimated, the over-identifying restrictions should be tested for the validity of the restrictions (Newey & West, 1987a). The GMM draws out the estimates of parameters with which the correlations between disturbances and instrumental variables are as close to zero as possible, i.e. the distance from the zero is the smallest. GMM is also robust to heteroskedasticity and autocorrelation by using a proper weighting matrix (Newey & West, 1987b). So this study uses the heteroskedasticity robust GMM with an econometric analysis package, EVIEWS 5.1 of Quantitative Micro Software (QMS).

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<sup>7</sup> We also included the two and three year lagged dependent variables for the set of instrumental variables as implied in dynamic panel data analysis (Arellano & Bond, 1991; Baltagi, 2001; Hsiao, 1986) because convergence in GMM estimation was not achieved even at the 10000 times iteration.

As a second step, after estimating the model of total alliance formation with equation 2, we estimate two models of explorative alliance formation and exploitive alliance formation with the following two equations respectively. We use GMM estimation method for each equation with consideration of fixed effect and heteroskedasticity robustness.

$$\text{Equation 3: Explorative alliances}_{t+1} = \alpha_0 + \alpha_1 * \text{RAMC\_below}_t + \alpha_2 * \text{RAMC\_above}_t + \alpha_3 * \text{Absorptive capacity}_t + \alpha_4 * \text{Competition}_t + A * \text{Control variables}_t + E_{it},$$

where  $A$  is coefficients of control variables and  $E_{it} = \delta_i + U_{it}$ ,  $\delta_i$  is a heterogeneous firm's fixed effect component of error term  $E_{it}$ ,  $i = 1, 2, 3 \dots 97$ ,  $t = 1, 2 \dots 5$ .

$$\text{Equation 4: Exploitive alliances}_{t+1} = \beta_0 + \beta_1 * \text{RAMC\_below}_t + \beta_2 * \text{RAMC\_above}_t + \beta_3 * \text{Absorptive capacity}_t + \beta_4 * \text{Competition}_t + B * \text{Control variables}_t + \Gamma_{it},$$

where  $B$  is coefficients of control variables and  $\Gamma_{it} = \gamma_i + \Psi_{it}$ ,  $\gamma_i$  is a heterogeneous firm's fixed effect component of error term  $\Gamma_{it}$ ,  $i = 1, 2, 3 \dots 97$ ,  $t = 1, 2 \dots 5$ .

However, as a final step of our model specification, because the explorative alliances and exploitive alliances comprise a firm's total alliances, we checked whether the two equations' error terms are contemporaneously correlated as in a seemingly unrelated regression (SUR) model (Greene, 1997). They were significantly correlated with significance level of 0.01. To correct for this contemporaneous correlation of error terms between two equations, we estimated the two equations with a correction of contemporaneous correlation of the error terms. Specifically, in the GMM estimation we used Newey and West's (1987b) weighting matrix which is robust to heteroskedasticity

and autocorrelation<sup>8</sup> thereby addressing the contemporaneous correlation among these two equations and autocorrelation of each equation. In sum, our final estimation of the equation 3 and 4 for explorative alliance and exploitive alliance is estimated by a multi equation model with correction of the contemporaneous correlation over the equations. But the equation 2 for total alliance is estimated by a single equation model.

## Results

Table1 shows the means, standard deviations, and bivariate correlation of variables we used in this analysis. The descriptive statistics shows that the average firm in the sample holds 4 explorative alliances and exploitive alliances respectively. The average firm of our sample data is 31 years old and has 8800 employee. The average firm's technical area is 4 and the number of cumulative patents of recent 5 years is averaged at 95. The average Low RAMC is 15 while the average High RAMC is 2. The R&D intensity shows R&D investment is 9 times larger than sales. On average, the firm faces 116 technical competitors. Although the descriptive table shows that correlations between certain variables are high, this is not so problematic because this study

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<sup>8</sup> To consider the fixed effect panel estimates of each equation in the multi equation estimation, we used "Q transformation" which replaces each variable in an equation with the deviation from the mean of each cross-section unit over time within each variable (Baltagi, 2001:13). For example,  $Y_{it} = a_0 + a_1 * X_{it} + u_i + v_{it}$ , where  $u_i$  is fixed effect component of each cross-section unit  $i$  in the error term. Through Q transformation such as  $QY = (Y_{it} - \bar{Y}_i)$  using each variable's mean of each cross-section over time, such as  $\bar{Y}_i$  and  $\bar{X}_i$ , we still have consistent coefficient estimates of explanatory variables such as  $X_{it}$  as in a fixed effect model; we have  $QY = a_1 * QX + Qv$ , where  $QY = (Y_{it} - \bar{Y}_i)$ ,  $QX = (X_{it} - \bar{X}_i)$ ,  $Qv = (v_{it} - \bar{v}_i)$ . In addition, to our model, the estimates of the multiple equation estimation are similar to those of single equation with fixed effect. However, because  $\bar{v}_i$  in the  $Qv = (v_{it} - \bar{v}_i)$  may create autocorrelation problem in a estimation of each equation (Baltagi, 2001: 130) and in each equation there was first lag autocorrelation, we address this problems in the GMM estimation using Newey and West's (1987b) weighting matrix option in the EViews 5.1.

estimates the models using panel data analysis and as a result has an advantage in dealing with multicollinearity among the variables (Baltagi, 2001; Hsiao, 1986)<sup>9</sup>. In addition, the relatively high correlation between the two alliance data, such as explorative alliance and exploitive alliance, also supports our multiple equation estimation with correction of contemporaneous correlation and autocorrelation as in seemingly unrelated regression (SUR) model.

Table 2 shows the result of a multiple equation estimation using GMM with correction of contemporaneous correlation and autocorrelation for explorative alliance and exploitive alliance as well as that of a single equation estimation for total alliance. However, before discussing the results of our tests, two issues about model specification are noted. First, the Durbin-Watson statistics show that exploitive alliance has no autocorrelation with its previous year while explorative alliance is located in 'Zone of indecision' (Gujarati, 2002: 469) where decision on rejection of autocorrelation hypothesis is not applicable with the Durbin-Watson statistics. Thereby we take regression of the current residuals of the estimated explorative alliance equation on previous year residuals. The result showed that the coefficient of the previous year

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<sup>9</sup> In appendix C we suggested correlations among variable which is transformed into the variables used in the panel data analysis because each variables are Q-transformed as introduced in the footnote 8.

Table 1  
Means, Standard Deviations, and Correlations

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1. Explorative alliance	3.722	6.367	1.000									
2. Exploitive alliance	4.054	5.679	0.772	1.000								
3. Age	31.129	39.649	0.319	0.335	1.000							
4. Size	8.843	23.146	0.599	0.518	0.607	1.000						
5. Technology diversity	3.704	5.939	0.550	0.386	0.347	0.604	1.000					
6. Innovativeness	94.984	202.610	0.552	0.392	0.380	0.585	0.848	1.000				
7. RAMC_below	14.908	7.266	-0.797	-0.745	-0.329	-0.599	-0.566	-0.573	1.000			
8. RAMC_above	2.061	7.942	0.815	0.796	0.331	0.530	0.359	0.375	-0.534	1.000		
9. R&D intensity	9.137	67.244	-0.061	-0.053	-0.059	-0.051	-0.057	-0.054	0.072	-0.034	1.000	
10. Competition	115.878	209.192	0.004	-0.027	-0.110	-0.095	0.035	0.004	-0.013	-0.046	-0.035	1.000

RAMC\_below was transformed into positive value by its absolute value to indicate the size.

Table 2  
The GMM Results of Each Equation

	Explorative alliance	Exploitive alliance	Total alliance
Constant	-0.1719 (0.1837)	-1.3890*** (0.2189)	-1.9596*** (0.2995)
Age	0.0839 (0.1469)	1.0308*** (0.1818)	0.7840*** (0.1829)
Size	-0.2827*** (0.0341)	0.1169*** (0.0269)	-0.7194*** (0.1423)
Technology diversity	-0.2113*** (0.0628)	-0.3103*** (0.0823)	-0.7548** (0.2382)
Innovativeness	-0.0044* (0.0022)	-0.0079*** (0.0022)	-0.0151* (0.0066)
RAMC_below	-0.2281*** (0.0498)	-0.5827*** (0.0630)	-0.3059*** (0.0499)
RAMC_above	0.5281*** (0.0255)	0.4178*** (0.0275)	1.1999*** (0.1522)
Absorptive capacity	-0.0002 (0.0005)	0.0030*** (0.0005)	0.0035* (0.0017)
Competition	0.0025*** (0.0009)	-0.0002 (0.0009)	0.0009 (0.0021)
R-squared	0.6728	0.5116	0.912061
Durbin-Watson stat	1.8121	1.9587	1.3140††
J-statistic	0.231162		14.44621

Standard errors in parentheses. †  $p < 0.1$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . The exploitive alliance and explorative alliance were estimated with a multiple equation model while total alliance was estimated with a single equation model. †† We checked autocorrelation with error terms of the equations, i.e. whether the error term  $E_{it} = \delta_i + U_{it}$  and  $U_{it} = \rho U_{it-1} + \varepsilon_{it}$ , in which  $\delta_i$  is a heterogeneous firm's fixed effect component of error term  $E_{it}$ . The  $\rho$  was not significant at 5% significance level with suggestion of no autocorrelation.

residual was not significant at even level of 10%; a hypothesis that the estimated coefficient is zero is statistically ‘not rejected’, i.e., accepted. Hence we concluded that there is no autocorrelation in the estimated equations, i.e. the correction of autocorrelation in the multiple equation estimation was properly made<sup>10</sup>. Second, we tested for the validity of over-identifying instrument variables in GMM estimation because the number of instrumental variables was greater than the number of estimated coefficients. For this purpose, the J-statistic, that minimizes the value of the objective function of GMM estimation, is used to test the hypothesis that the over-identifying restrictions are valid using a chi-square distribution (Newey & West, 1987a). With degree of freedom equal to the number of the over-identifying restrictions (here, 34), the hypothesis of the validity was accepted even at the 10% significance level<sup>11</sup>.

The hypotheses of this study were then tested using the GMM technique on these equations (i.e., equation 2, 3 and 4). To test hypothesis 1a, we checked whether total alliance formation which is the sum of explorative alliance formation and exploitive alliance formation was monotonically increasing or decreasing regardless of a firm’s *RAMC\_below* or *RAMC\_above*. Given that we had converted the *RAMC\_below* variable to absolute value terms, the inverted U-shaped relationship between the alliance formation and a firm’s AMC should have negative signs coefficients for not only the

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<sup>10</sup> We also checked autocorrelation for the total alliance model with error terms of the equations, i.e. whether the error term  $E_{it} = \delta_i + U_{it}$  and  $U_{it} = \rho U_{it-1} + \varepsilon_{it}$ , in which  $\delta_i$  is a heterogeneous firm’s fixed effect component of error term  $E_{it}$ . The  $\rho$  was not significant at 5% significance level with suggestion of no significant autocorrelation.

<sup>11</sup> This was also tested for the total alliance model with a result that the over-identifying restrictions were significantly valid even at a significance level of 10%.

*RAMC\_above* variable but also for the *RAMC\_below* variable. Namely, the larger the value that the variable *RAMC\_below* takes, the further removed is the firm's cumulative experiences are from the point of diminishing returns. Therefore, in accordance to the invert U shaped relationship, this larger deviation from this point of diminishing returns should lead to a reduction in the number of alliances formed. Hence, this yields a negative sign coefficient between *RAMC\_below* and alliance formation. While, similarly, larger values for the variable *RAMC\_above* reflect larger distances from the point of diminishing returns and thus in accordance to inverted U Shape relationship, should lead to a reduction in the number of alliances formed. To test these non-monotonic effects, the results of table 2 show the estimates of the coefficients of *RAMC\_below* are significantly negative, but those of *RAMC\_above* are significantly positive respectively at 0.1% significance level for total alliance formation ( $\eta_1 = -0.3059$ ,  $\eta_2 = 1.1999$ ). This result indicates despite arguments for a diminishing return effect, a firm's alliances formation is generally positively related to a firm's Relative AMC. This tendency is also observed with explorative alliance formation and exploitive alliance formation. Thereby, these results does not support hypothesis 1a.

Hypothesis 1b was tested by comparing the size of coefficients of *RAMC\_below* between explorative alliance formation and exploitive alliance formation. While, hypothesis 1c was tested by comparing the size of coefficients of *RAMC\_above* between explorative alliance formation and exploitive alliance formation. For hypothesis 1b with results shown in table 2, the Wald test with  $H_0: \alpha_1 = \beta_1$ ,  $H_1: |\alpha_1| < |\beta_1|$ , in which  $\alpha_1 = -0.2281$  and  $\beta_1 = -0.5827$  are both negative, using the notations of equation 3 and



4 for convenience, these results shows that  $H_0$  is rejected at the 0.1% significance level (chi-square =14.77576,  $p = 0.0001$ ) and thereby satisfies the hypothesis 1b. For hypothesis 1c with result at table 2, a Wald test with  $H_0: \alpha_2 = \beta_2$ ,  $H_1: \alpha_2 > \beta_2$ , in which  $\alpha_2 = 0.5281$  and  $\beta_2 = 0.4178$ , shows that  $H_0$  is rejected at the 5% significance level (chi-square = 5.151931,  $p = 0.0232$ ). Thereby, these results support the arguments of hypothesis 1c.

The hypothesis 2a and 2b examines the effect of a firm's absorptive capacity - as measured by the coefficients of a firm's R&D intensity- on alliance formations. Hypothesis 2a was tested by checking the effect of absorptive capacity on a firm's total alliance formation. As shown in table 2, the estimated coefficient,  $\eta_3 = 0.0035$ , is significant at the 5% level and is positive. For hypothesis 2b, the unique effects of absorptive capacity on explorative alliance formation and exploitive alliance formation are examined. The Wald test using  $H_0: \alpha_3 = \beta_3$ ,  $H_1: \alpha_3 < \beta_3$ , with  $\alpha_3 = -0.0002$  and  $\beta_3 = 0.0030$  shows that  $H_0$  is rejected at 0.01% significance level (chi-square = 19.78876,  $p = 0.0000$ ). Thereby, this result supports the argument of hypothesis 2b in which absorptive capacity promotes the formation of exploitive alliances more than that of explorative alliance.

Hypothesis 3a and 3b examines the effect of competition on alliance formation. In hypothesis 3a we examined the effect of competition on total alliance formation by testing whether the estimated coefficient of competition is significantly positive. The estimated coefficient,  $\eta_4 = 0.0009$  was positive but not significant even at the 10%

significance level. We can not tell that hypothesis 3a is satisfied due to the insignificant result of the effect of competition on total alliance formation even though it was positive. For hypothesis 3b, we compared the effects of competition on explorative alliance formation and exploitive alliance formations. Wald test  $H_0: \alpha_4 = \beta_4$ ,  $H_1: \alpha_4 > \beta_4$ , with  $\alpha_4 = 0.0025$  and  $\beta_4 = -0.0002$  shows that  $H_0$  is rejected at 5% significance level (chi-square = 3.044041,  $p = 0.0810$ )<sup>12</sup>. This result supports the argument of hypothesis 3b.

In addition, to account for control variables in our analysis, the result from table 2 shows that the larger the size of the firm (i.e. employees), the greater the formation of exploitive alliances. Older firms as measured by age favor exploitive alliances rather than explorative alliance formation because exploitive alliance tends to leverage past experiences. However, a firm's innovativeness –as measured by cumulative patents- and technology diversity –as measured by patents- both have negative effects on alliance formation regardless of alliance types.

## DISCUSSION AND IMPLICATIONS

This study examined the determinants of alliance formation- diminishing return effect of alliances, absorptive capacity and competition, which have not been considered by AMC explanation. Unlike our expectation, diminishing return effect of alliance did not have significant effect on alliance formation in terms of total alliance. However,

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<sup>12</sup> Because EViews 5.1, a statistical package we use for estimation, shows the  $p$ -value based on two-sided test, the  $p$ -value at one-sided test as in our study must be divided by 2 as in EViews 5.1 user's guide (Quantitative Micro Software, 2005: 451).

despite this lack of significance, the point of diminishing returns appears to distinctly influence the formation of different types of alliances, i.e., explorative alliance and exploitive alliance. A firm's absorptive capacity and its external competition had also significant influences to alliance formation in terms of both total alliances and different types of alliances.

In explaining these findings, the lack of diminishing return effects for total alliances could be explained by two reasons involving a firm's response to risk or measurement error regarding the constructing of variables. First, with respect to a firm's response to risk, when a firm faces declines in its return, the firm rather takes more risks, such as increasing alliance formation. As prior research argued, alliance formation faces a high risk of fail. Prior research argued that the failure rate of alliances reaches 40 to 70% (Dyer et al., 2001; Heimeriks et al., 2009; Kale et al., 2002; Park & Ungson, 2001). Such risk taking with declines in a firm's return was also empirically supported by a fact that troubled firms tend to take more risky actions (e.g. Bowman, 1980; Bromiley, 1991, Fiegenbaum & Thomas, 1988; March & Shapira, 1987). This was also partly supported by our results about the formation of specific types of alliances. That is, explorative alliance which is regarded as a more risky alliance was increased more than the less risky alliance, i.e., exploitive alliance. In addition, with respect to measurement error regarding the construction of our variables, the optimal return was held to be the same for all panel members in constructing diminishing return point. Even though we constructed the diminishing return point considering heterogeneity of each firm in panel data analysis, it would be better to consider each panel member's optimal return level

individually. To address this problem, a sufficiently long times series data for each panel members is required. This will be a subject of future research.

Our empirical result also shows that the alliance formation is affected by a firm's internal and external factors as previous research has argued (Koza & Lewin, 1998; McKelvey, 1997; Patzelt et al., 2008; Park et al., 2002). A firm's internal learning capacity, i.e. absorptive capacity was positively related to the alliance formation as suggested by previous research (Nicholls-Nixon & Woo, 2003; Tsai, 2001; Van den Bosch et al., 1999; Zollo et al., 2002). However, a firm's absorptive capacity's effect on alliance formation was distinct depending on the types of alliances. The empirical result of this study shows that explorative alliance formation was not increased by a firm's absorptive capacity while exploitive alliance was. This result implies that due to the path dependent nature of absorptive capacity, it can enhance a "substitution effect" between that of the explorative and exploitive alliances. That is, the path dependency of a firm's absorptive capacity leads to increase in the exploitive alliances to which create rigidities in exploring new opportunities that are associated with explorative alliances (Cohen & Levinthal, 1990; Leonard-Barton, 1992; Levinthal & March, 1993; Levitt & March, 1988).

A firm's external competition in a general sense has also been found to positively impact the formation of alliances as suggested by previous research (e.g. Dickson & Weaver, 1997; Koza & Lewin, 1998; Park et al., 2002; Patzelt et al., 2008). However, the specific impact was different depending on the types of alliances. This study shows that the effect of competition on explorative alliance formation is positive while the

effect of competition on exploitive alliance formation is negative but insignificant. This result is consistent with previous empirical findings that competitive market encourages explorative alliance formation (e.g., Park et al., 2002). As competition becomes severe and thereby the firm's competitive advantage is increasingly threatened, a firm's inertial force gives way to new path or new experimentations that encourage exploration (Levinthal & March, 1993; March, 1991; Lavie & Rosenkopf, 2006; Voss et al., 2008). Deephouse (1999) also argued that due to imitation by competitors, firms increasingly seek to differentiate as competition is intensified. The explorative alliances better serves such differentiation activities than exploitive alliances because exploration is related to experimentation of new opportunities while the exploitation is related to refinement of current capabilities (Koza & Lewin, 1998). Thus, competition becomes a significant determinant to formation of different types of alliances.

Finally, this study has several limitations which may lead to a future research agenda. First, we did not link the specific managerial techniques in the alliance management to the alliance formation. The specific managerial techniques such as alliance evaluation, usage of alliance specialists, and alliance training (Draulans et al., 2003; Heimeriks et al., 2009) may provide more specificity on alliance formation and can provide considerable implications to practitioners. Second, our empirical calculation of the diminishing return level in the alliance management capability needs some caution in their interpretation. Because the calculation is based on our panel dataset of 97 pharmaceutical companies over 6 years with consideration of fixed effect of the firms, the result of the calculation is not an absolute value, but rather a changeable value

depending on data set. For example, Rothaermel and Deeds' (2006) empirical research based on 325 biotech firms showed the diminishing level of around 12 alliances. This result is however based on 32 large pharmaceutical firms that had a level of 26 in terms of number of exploitive alliances<sup>13</sup>. Because of the difference in several aspects related to the panel dataset such as year range and number of firms, the diminishing return level of the alliances are different among the above empirical research.

Our study provides some crucial implications to practitioners such as managers of the alliances. Because alliance formation is significantly influenced by a firm's absorptive capacity and competition, managers need to account for their firms' absorptive capacity and the competitive environment. Furthermore, because a firm's absorptive capacity is highly path dependent it impacts the formation of exploitive alliance especially under competitive conditions. Managers should understand the effect of absorptive capacity and competition to better balance the formation of different types of alliances.

This study has several contributions to alliance research, especially to alliance management capability research. First, because empirical examinations of the determinants of alliance formation, especially with respect to exploration and exploitation are limited, this study contributes to addressing these shortcomings<sup>14</sup> (see,

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<sup>13</sup> We calculated these levels from the results presented in their research. In addition, the level for explorative alliance of Rothaermel and Deeds's (2004) was around 20 but the estimates of the coefficient of the explorative alliance were not significant.

<sup>14</sup> As Lavie and Rosenkopf (2006) argued, the determinants of the explorative and exploitive alliances have been mostly limited to market uncertainty and turbulence (Beckman, Haunschild, & Phillips, 2004; Park et al, 2002; Rothaermel, 2001; Rothaermel & Deeds, 2004; Rowley, Behrens, & Krackerhardt, 2000) and extent of resource abundance (Park et al, 2002).

Lavie & Rosenkopf, 2006). This empirical study supports the substitution effect between exploration and exploitation in alliance formation (Koza & Lewin, 1998; Lavie & Rosenkopf, 2006) to which absorptive capacity can play a mediating role. Second, absorptive capacity has not been formally tested in the context of exploration / exploitation alliance formation (see, Lane & Koka 2006; Lane & Lubatkin, 1998). In that regard, this study contributes to this area because to our knowledge, the effects of absorptive capacity on explorative and exploitive alliances have not been empirically examined. Finally, the consideration of competition as an important factor impacting alliance formation could extend the alliance management capability beyond firm level considerations.

## **CHAPTER IV**

### **RISK PREFERENCE IN ALLIANCE FORMATION IN THE PHARMACEUTICAL INDUSTRY**

#### **INTRODUCTION**

A firm's risk preference is often revealed by its strategic choice on risky alternatives (Das & Teng, 2001; Fiegenbaum et al, 1996; Hambrick & Mason, 1984). Traditionally, risk preference has been assumed as fixed as in financial portfolio theory. The portfolio theory assumes that decision makers such as firms are risk averse and thereby they take risk only if they are compensated by high returns. As a result of risk aversion, financial portfolio theory argues for 'positive relationship' between risk and return (Fiegenbaum et al, 1996). However, the positive relationship between risk and return is often not supported in the context of alliance formation because firms have been found to undertake the formation of risky alliance even though the expected return are not commensurate with such risks (Park & Zhou, 2005; Rothaermel & Deeds, 2006). Previous empirical research about alliance formation showed that the highly risky alliances face lower returns than lower risk alliances (Deeds & Hill, 1996; Rothaermel & Deeds, 2006). For instance, in a pharmaceutical industry the rate of an approved drug of a high risk alliance was reported as 14% while that of a low risk alliance was 26% (Lerner et al., 2003; Rothaermel & Deeds, 2006). This empirical finding implies firms form alliances that have high risk face low returns. This not only contradicts risk aversion assumption of portfolio theory, but also the positive risk-return trade-offs.



Thereby, the objective of this study is to resolve a research question: ‘why do firms form risky alliances that have low returns?’

One explanation to this paradox is prospect theory. The prospect theory and more broadly behavioral approaches argue risk preferences are not fixed (March & Shapira, 1987; Sitkin & Pablo, 1992; Sitkin & Weingart 1995; Kahneman & Tversky, 1979). This body of research argues that a firm’s risk preference varies with distance from a given reference point. In particular, a firm becomes a risk seeker when its return fall below a reference point, such as average profit of an industry or a firm’s historical profits, and conversely the firm is risk averse when its returns fall above this reference point (Fiegenbaum & Thomas, 1988; Lehner, 2000; Kahneman & Tversky, 1979). Thus, when a firm’s returns are relatively low to its reference point, the firm is more likely to form a high risk alliance. Conversely, when a firm’s return is relatively high to its reference point, the firm will prefer the formation of low risk alliance than that of high risk alliance. Hence, prospect theory and related behavioral theories can provide insights to our research question.

However, despite a growth of behavioral explanations in management research, prospect and behavioral explanations of risk preferences have been rarely applied in the context of alliance formation (see Das & Teng, 1996; Brass et al., 2004; Bromiley, Miller, & Rau, 2001; Gulati, 1998; Inkpen, 2001; Ireland et al., 2002 for review of alliance formation and risk related research in strategic management). A firm’s risk preference is likely to impact the choice of different types of alliances because risk preference can be revealed by a firm’s choice over different risky alternatives. In

particular, as risk seeking behavior involves activities with uncertain and generally costly activities, risk seeking preferences can thus be revealed by a firm's high risk alliances while risk aversion can be revealed by a firm's choice of low risk alliances. Conceptually, a high risk alliance is an alliance of which outcome is relatively more uncertain, requires more time and effort than that of low risk alliance. For instance, in the pharmaceutical industry, Rothaermel and Deeds argued that in terms of the unpredictable nature of alliances, alliances focusing on basic research, drug discovery and development are relatively more risky than alliances that target on "commercialization (clinical trials, FDA regulatory process, and marketing and sales)" (2004: 209-210). The former type of alliance has been also argued as more costly and time-consuming than the latter types of alliances because R&D activities need more coordination in intra- and inter-firm relations (Pisano, 1990; Rothaermel & Deeds, 2006; Teece, 1992).

Although prior research (e.g., Deeds & Hill, 1996; Park et al., 2002; Powell et al., 1996; Rothaermel & Deeds, 2004, 2006; Shan et al., 1994) has examined a firm's choice of these types of alliances, they have not given a behavioral explanation for such choices. This study argues choices in these different types of alliances are the result of changes in a firm's risk preferences that varies according to deviations between a firm's performance and its reference point. That is, this study applies the reasoning of prospect theory and behavioral theory to explaining the underlying risk preferences that impact the choices of these different types of alliances.

When it comes to a firm's reference point or aspiration level, it is often dependent on 'comparison to relevant others (i.e., industry norm or average) or to its own past performance' (Bromiley et al., 2001; Cyert & March, 1963; Greve, 1998; Lant, 1992). Thus, a firm's past performance (i.e., experience) may increase or decrease the reference point or aspiration level. Furthermore, because a firm's past experiences in the development of new technologies impact a firm's performance, such experiences can therefore also influence a firm's risk preference. Furthermore, a firm's technology choices also serve to reflect a firm's risk preferences. For instance, the development of a technology dissimilar to a firm's prior technologies can be regarded as risk taking experience while the development of technologies similar to a firm's established fields of expertise can be regarded as risk aversion experience. This is because the dissimilar technologies are relatively more difficult to develop and their expected outcomes are more uncertain than technologies based on similar experiences. Hence, this study examines the experience effect, especially a new technology experience effect, on risk preference in alliance formation.

In organizing this study, this study's unit of analysis, definitions and assumptions are stated. The study's theoretical developments follow in which testable hypotheses are developed. The next section provides a discussion of the data and panel estimation using generalized method of moment (GMM). A discussion of the results follows. Lastly, the study's conclusions, implications and contributions are examined.

## CONCEPTUAL FOUNDATIONS

### Unit of Analysis

Because a firm's choice over different types of risky alliance is a consequence of the firm underlying risk preference, the unit of analysis is at the firm. This firm level analysis includes the formation of alliances with different levels of risks; that includes relatively high risk alliances, such as R&D and drug discovery related agreements and low risk alliances, such as marketing, distribution, and sale related agreements (Pisano, 1990; Rothaermel & Deeds, 2004, 2006; Teece, 1992).

### Assumptions and Definitions

Because there is no prior research about risk preference and its measure in alliance formation research, this study makes the assumption that a firm's strategic choice over risky alternatives reveals its risk preference<sup>15</sup>. In other words, in the context of alliance formation, a firm's risk preference is defined through its strategic choices over alliances that vary in their risks characterized by high and low risk alliances. From here on, we refer alliance formation to a choice between high risk alliance and low risk alliance. Based on Sitkin and Pablo (1992), the riskiness of an alliance is based on the predictability of the expected outcome of alliances and the cost or difficulties in

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<sup>15</sup> This is also a basic assumption used in the construction of experiment-based utility function (e.g., Abdellaoui, Bleichrodt, & Paraschiv, 2007; Abdellaoui, Bleichrodt, & L'Haridon, 2008) as well as in choice theory of neo classical economics (e.g., Mas-Colell et al, 1995). However, this assumption does not equal to the assumption of the 'weak axiom of revealed preference' as in choice theory of neo classical economics. The weak axiom asserts that for alternatives x and y, if x is ever chosen over y when both are feasible, "x is revealed at least as good as y" but this preference is constant as long as both alternatives are feasible (Mas-Colell et al, 1995). We agree with the revealed preference of x over y if x is chosen over y, but we do not accept its constancy because the preference can be changed by other factors (Machina, 1987).

achieving the expected outcome. Conceptually, the high risk alliance is an alliance of which outcome is relatively more uncertain and requires more time and effort than that of low risk alliance. Since this paper assumes a firm's choice of its alliance risk is a result of its risk preference, the concept of risk taking (or risk aversion) in alliance formation is defined by a ratio of high risk (or low risk) alliance formation to total alliance formation. Changes in a firm's risk preference can thus be examined by observing how this ratio is changed.

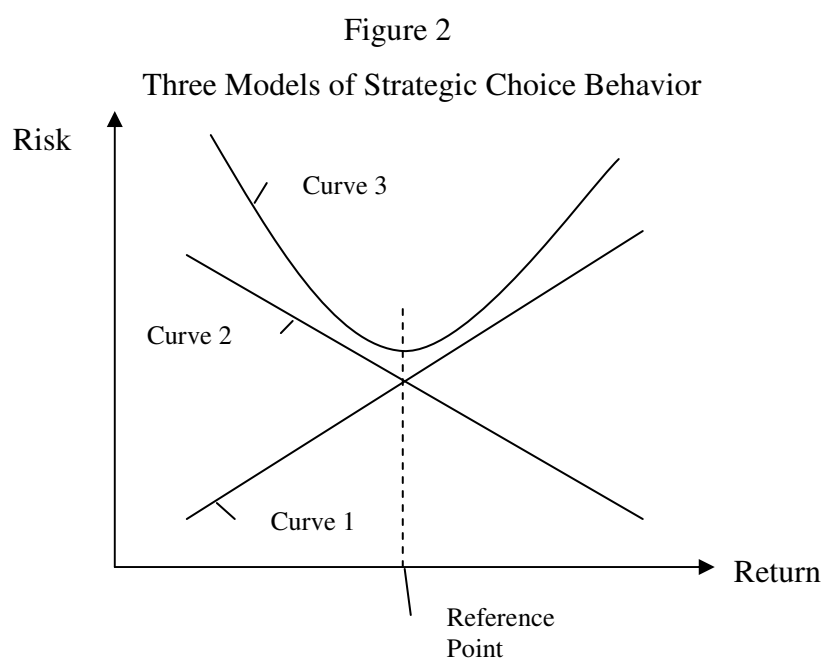
This study also argues that a firm's risk preference at alliance formation is impacted by a firm's experience in a new technology development. To develop this argument, we assume that a firm's risk preference is also revealed by the firm's experiences with a technology. Specifically, the development of a technology similar to a firm's prior technology is regarded as risk aversion experience while a technology that involve dissimilar technology is regarded as risk taking experience.

## **THEORY DEVELOPMENT AND HYPOTHESES**

### **Prospect Theory: Risk Behavior**

Risk has been an essential element of strategic choice behavior of organizations (e.g., Bromiley et al., 2001; Fiegenbaum et al., 1996; Ruefli, Collins, & Lacugna, 1999). Strategic choices are reflection of one's risk preference (Das & Teng, 2001; Hambrick & Mason, 1984). Risk preference has been traditionally assumed as fixed and has been extensively examined in Financial Portfolio theory. Most prevalent assumption has been

that firms are risk averse and to which yields positive risk-return relationship. That is, firms take on higher risk only if they are compensated by high returns (Bettis, 1981; Schoemaker, 1982). However, this positive relationship between risk and return has been also challenged by empirical findings that firms increase returns and reduce risk concurrently<sup>16</sup> (Bowman, 1980; Cool & Dierickx, 1987; Fiegenbaum et al., 1996; Fiegenbaum & Thomas, 1986). As in figure 2, the mixture of these two relationships, i.e., positive and negative relationship in the risk-return interface, has been a subject of discussion in prospect theory and behavioral theory.



Curve 1: risk-averse behavior. Curve 2: risk-seeking behavior and / or good managers can increase return and reduce risk simultaneously. Curve 3: risk-seeking and risk-averse behavior in the domain of losses and gains respectively (Fiegenbaum et al., 1996: 221).

<sup>16</sup> The negative relationship was also described in an opposite way, i.e., troubled firms take more risk which leads to worse performance (Bowman, 1982; Bromiley, 1991).

Based on the prospect theory of Kahneman and Tversky (1979), they find that individuals whose returns fall below a reference point tend to be ‘risk taking’ while individuals tend to be ‘risk avoiding’ when returns fall above this reference point. Such arguments have been empirically supported at the firm level (Fiegenbaum & Thomas, 1988; Lehner, 2000). March and Shapira’s (1987) survey that is based on interviews with numerous managers also showed that risk taking increases as a firm’s return departs from their aspiration level, as measured by an industry average return or a firm’s past returns. Fiegenbaum and Thomas (1988) and Bromiley (1991) empirically supported this with findings that indicate firms with returns below this aspiration level or reference point took on greater risks. Fiegenbaum and Thomas (1988) and Bromiley (1991) also found that firms who earn returns beyond this aspiration or reference point did not take on greater risk. Hence, these findings not only offered a fundamental challenge to the traditional assumption of risk preference but also provided a new base to interpret a firm’s behavior in relation to the risk / return paradox, such as the negative relationship in alliance formation between high risk alliance formation and its low expected return. This is further elaborated in the next section.

### **Strategic Risk Behavior in Alliance Formation**

Though firms form strategic alliances as a way to reduce risk in uncertain environments (Hagedoorn, 1993; Kogut, 1991), there is no prior research about a firm’s risk preference, i.e., a firm’s risk taking or risk aversion, in the alliance formation research (see Brass et al., 2004; Bromiley et al., 2001; Gulati, 1998; Inkpen, 2001;

Ireland et al., 2002 for review of alliance formation and risk related research in strategic management). Furthermore, because the traditional explanation of risk preference is often inconsistent with alliance formation, we examine whether prospect theory and behavioral theory can explain the risk preference in alliance formation. Specifically, this study focuses on whether a firm's risk preference in regards to choice of high / low risk alliances is dependent on the firm's relative performance to its reference point or aspiration level.

The distance from a firm's reference point or aspiration level of return impacts a firm's strategic choice over different risky alliances because the different alliances make different contributions to a firm's return. Because high risk alliance focuses on basic research and development, such as drug discovery in pharmaceutical industry, it provides a new source of opportunity for a firm's return (Koza & Lewin, 1998; Rothaermel & Deeds, 2004). The discovery of a new opportunity is important to sustain a firm's return in a competitive market because competitors increasingly undermine the foundation of its current return (Hitt, Ireland, Camp, & Sexton, 2001; Venkataraman & Sarasvathy, 2001). Conversely, low risk alliance provides refinement of a current opportunity to which involve activities that targets commercialization such as marketing and sales to which yield more immediate but incremental returns to a firm (Koza & Lewin, 1998; Rothaermel & Deeds, 2004).

High and low risk alliances have different impacts on a firm's returns (Gulati, 1998; Ireland et al., 2002). Namely, high risk alliance is more likely to yield greater returns than low risk alliances because high risk alliances can enhance a firm's



competitive position or market power. In other words, because the number of partners in a R&D related agreement is relatively more limited than in a sales or marketing related agreement, the high risk alliance enables the firm to access relatively more rare resources (Zucker, Darby, & Brewer, 1998). High risk alliance thereby prevents its competitors' access to critical resources than the low risk alliance due to such limits in the number of partners (Silverman & Baum, 2002; Zucker et al, 1998).

Hence, in accordance to the logic of prospect theory, when a firm's return falls below its reference point, the situation is more likely to reflect a declining competitive position. Thereby, greater efforts are made to seek a new opportunity to restoring a firm's declining competitive position. High risk alliances are more likely to be chosen to discover new opportunities because they provide new sources of competitive advantage. This is also supported by an empirical finding that the tendency to take more risky actions is higher in troubled firms (Bowman, 1982; Bromiley, 1991; Greve, 1998; Wiseman & Bromiley, 1996). On the contrary, when a firm's return exceeds the reference point, a firm's competitive position is thereby being rewarded by the market and thereby requires no further development. Firms are more likely to focus on refining or exploiting the current opportunity. Thereby, low risk alliance that leverages a firm's existing competitive advantage is more likely to be chosen when a firm's return exceeds the reference point. As a result consistent with prospect theory (e.g., Kahneman & Tversky, 1979) and behavioral theory of firm (e.g., March & Shapira, 1987), a firm undertakes more risky alliance (i.e. risk taking) when its return falls below its reference

point. Conversely, a firm undertakes less risky alliances when a firm's return exceeds its reference point. We hypothesize these arguments.

*Hypothesis 1a: A firm's risk taking in alliance formation – the ratio of high risk alliance formation to total alliances – will be increased as a firm's return falls below its reference point.*

*Hypothesis 1b: A firm's risk aversion in alliance formation – the ratio of low risk alliance formation to total alliances – will be increased as its return exceeds its reference point.*

A firm's risk preference is influenced by its reference point or aspirations. However, since this reference point or aspirations is influenced by a firm's past experiences, the firm's risk preference is likely to be influenced by its past experience. The next section thereby examines this past experience effect on a firm's risk preference.

### **The Effect of Risk Taking Experience on Alliance Formation**

According to prospect theory and behavioral theory a firm's risk preference is dependent on its reference point or aspiration level and thereby as the reference point or aspiration level is changed the risk preference is also likely to be changed. A firm's reference point or aspiration level is often determined based on a 'comparison to relevant others (i.e., industry norm or average) or to its own past performance' (Bromiley et al., 2001; Cyert & March, 1963; Greve, 1998; Lant, 1992). Lehner's (2000) used both industrial average and individual firm's prior performance in empirically estimating the reference point. As a firm's past performance is continually increased, the firm's

reference point or aspiration level will be increased. However, a firm's reference point or aspiration level can also be highly influenced by 'comparison to relevant others', i.e., industry norm or average (Bromiley et al., 2001). Hence, the reference point or aspiration can be defined as a weighted function of both individual and industry performance. However, as argued in prior research, industrial norm or average has been generally utilized as a reference point implying that industrial average has a greater weight in the estimation of the reference point than the individual performance (Bromiley et al., 2001).

Thereby, a firm's new technology development experience that impacts its performance can have different influence on its risk preference depending on the characteristics of the technology. That is, whether the firm's new technology was similar or dissimilar to its prior technology may have different impacts on its future risk preference. Although both technologies, similar or dissimilar technology, may have positive impact on a firm's performance and as a result increase its reference point, the dissimilar technology is more likely to have significant increase in the performance. This is because dissimilar technology is less likely to be imitated by a firm's competitors than the similar technology. Increase in performance through such technology, thereby, is more likely to lead to a level of performance that exceeds a firm's aspirations, especially aspirations that are influenced by industry norms or average. As a result of such technology development, the firm is less likely to increase its risk taking in developing a new dissimilar or innovative technology.

Furthermore, through a firm's history of new technology development, we can examine the effect of firm's prior risk taking (or risk aversion) experience, such as their prior technology choices, on a firm's preference for high and low risk alliance. This is because the new technology development can be interpreted as risk taking or risk aversion depending on whether the new technology is similar or dissimilar to the firm's prior technologies. The dissimilar technologies are relatively more difficult to develop and their expected return is also relatively more uncertain. Thereby, the development of a new technology dissimilar to a firm's prior technologies can be regarded as risk taking experience while a similar technology development is regarded as risk aversion experience. This is because improving or refining a current technology is less uncertain and less expensive than developing a new technology which is dissimilar to a firm's current technology (Danneels, 2002, 2007; Lavie, 2006). Furthermore, the improvement of current technology is relatively easier due to learning curve (experience) advantages (Cohen & Levinthal, 1990; Danneels, 2002, 2007; Lavie, 2006; Levinthal & March, 1993). Therefore, we can argue the effect of a firm's risk taking experience on the firm's risk preference in alliance formation through utilizing its new technology development experience as follows.

*Hypothesis 2: Risk taking experience in a new technology development has a negative impact on the risk taking in future alliance formation, i.e., the ratio of formation of high risk alliance to total alliances.*

## METHODS

Since a firm's relative return to the reference point or aspiration level is a key to explaining risk preference in prospect theory or behavioral theory, we start with giving the explanation of the estimation of a firm's '*Relative return to a reference point (RRRP)*' which is deviation from a firm's reference point. RRRP is constructed as the difference between a firm's current return on asset (ROA) and the reference point. In developing measures for the reference point, it is commonly constructed with an industry median return or a full sample average return. However, this study follows Lehner's (2000) approach to find the reference point because his approach is directly based on prospect theory (Fiegenbaum & Thomas, 1988; Lehner, 2000). Furthermore, his approach is better suited to risk preference research because the approach considers possibilities of shifts of individual reference level in the estimation of the reference point. That is, he relaxed an assumption about "common reference level for all firms of an industry" by more directly considering shift of individual reference point in his measure (Lehner, 2000: 63). Technically we more strongly supported his approach by adopting 'fixed effect panel data estimation' to consider heterogeneous firms' individual effect.

Lehner's (2000) identifies the reference point in three steps; 1) Estimation of a minimum risk point in the sample (Fiegenbaum et al., 1996; Lehner, 2000; Kahneman & Tversky, 1979), 2) finding the median point for the industry (Fiegenbaum & Thomas, 1988; Fiegenbaum, 1990) using COMPUSTAT database and 3) combination of above two points with a weight on each point. For the weight, he used the proportion of explained variance ( $R^2$ ) in the first regression model, i.e., equation 1, used to estimate the

minimum risk point, because the estimator of the minimum risk point as a reference point will be weak in meaning if the fit ( $R^2$ ) of the model is low. In other words, the reference point is calculated with the following equation;

$RP_n = \bar{R}^2 * RMP_e + (1 - \bar{R}^2) * IMD$ , where  $RP_n$  is the  $R^2$  weighted reference point,  $RMP_e$  is an estimated risk minimum point of a firm's ROA from the sample, and  $IMD$  is an industry-median ROA, in which  $\bar{R}^2$  is the proportion of explained variance in the regression model. Because the measure of fit,  $R^2$ , has a tendency to increase as more right hand variables are added in a model, we used the adjusted  $R^2$  as an alternative, which is expressed as  $\bar{R}^2 = 1 - (1 - R^2) * \frac{T-1}{T-k}$ , where  $T$  is the number of total observations and  $k$  is the number of parameters in the model (Gujarati, 2002).

The regression model for the estimated minimum risk point is shown in the equation 1. This equation is estimating the U-shaped relationship between the risk and return. *Equation 1:*  $|d_{it}| = \alpha_0 + \alpha_1 * Q_{it-1} + \alpha_2 * Q_{it-1}^2 + V_{it}$ ,  $\alpha_2 \geq 0$ , where  $|d_{it}|$  is the square root of  $d_{it}^2$  which is the mean of quadratic differences over past five years

$(d_{it}^2 = \frac{1}{4} \sum [Q_{it} - Q_{it-1}]^2)$ , as a representation of firm risk, i.e., volatility of ROA at time  $t$

(Bromiley et al., 2001; Lehner, 2000; Ruefli et al., 1999). As right hand side variables,  $Q_{it-1}$  is a firm's ROA at time  $t-1$ ,  $V_{it} = a_i + U_{it}$ , and  $a_i$  is the fixed effect component of error term,  $V_{it}$ ,  $i = 1, 2, 3 \dots 97$ ,  $t = 1, 2 \dots 5$ . We used a fixed effect model of panel data because risk may be distinct depending on each firm and there will be an unobservable

firm-based factor such as each firm's different experience (Sitkin & Pablo, 1992; Sitkin & Weingart, 1995). Even though the  $d_{it}^2$  is known as twice the variance of the time series when there is no autocorrelation and trend (i.e., stationary time series), this measure of risk is better than the return's variance, a traditional risk measure. This is because statistically the mean quadratic difference is not dependent on the return's mean and thereby the statistical correlation between the mean and variance is avoided, which has been one of criticism in the traditional risk measure (Bromiley, 1991; Bromiley et al., 2001; Lehner, 2000; Ruefli, 1990, 1991; Ruefli et al., 1999). The estimation result of this equation as in the table 3 shows that the computed value for the reference point ( $RP_n$ ) is -29.161 of ROA<sup>17</sup>. Given this point the RRRP is thus constructed as the difference in a firm's return (ROA) from this reference point.

## Data and Sample

To examine a firm's risk preference towards alliance formation, this study's hypotheses are empirically examined in the pharmaceutical industry. This is because alliances of various degrees of risk have been reported in the pharmaceutical industry (e.g. Powell et al., 1996; Rothaermel & Deeds, 2004, 2006). To examine alliances in this industry alliance data was drawn from Bioscan (American Health). Bioscan has been used in various pharmaceutical studies (e.g. Deeds & Hill, 1996; Powell et al., 1996; Rothaermel & Deeds, 2004; Shan et al., 1994). To develop a firm's reference

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<sup>17</sup> The industry-median ROA (*IMD*) was -21.9705 which is a median value of COMPUSTAT database for SIC 2834.

Table 3  
The Result of Estimation to Find the Minimum Risk

	Risk in return
Constant	0.353291*** (0.089296)
ROA	0.335805*** (0.086695)
ROA <sup>2</sup>	0.001294** (0.000479)
Firm Age	-2.090593*** (0.048486)
Firm Size	0.450813*** (0.079814)
R-squared (R <sup>2</sup> )	0.082269
Adjusted R-squared ( $\bar{R}^2$ )	0.066714
Sum of squared residuals	42696.65
J-statistic	24.92468
Standard errors in parentheses. † p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001	

point, financial data from the COMPUSTAT database of Standard and Poor (e.g. Lehner, 2000), and Mergent Online were used. To examine a firm's experience in advancing a new technology, the patent database of United States Patent and Trademark Office (USPTO) were used (e.g. McGrath & Nerkar, 2004; Nooteboom, Haverbeke, Duysters, Gilsing, & van den Oord, 2007; Zhang et al., 2007).

From these data sources, a panel data set of public pharmaceutical firms was constructed with 6 years of data from 1999 to 2004<sup>18</sup>. Over this sample period 326 bio and pharmaceutical firms were identified in the Bioscan data base. However, since the

<sup>18</sup> Because the date of the Bioscan data used in the study was not the end of December a given year, we used the 2005 Bioscan data to fully include a firm's activities such as alliance formation of year 2004. The dependent variable of the current study is a longitudinal data from 2000 to 2004.



focus is only on pharmaceutical firms, 105 of the 326 firms with standard industrial classification (SIC) code of 2834 (*'pharmaceutical preparations'* (Rothaermel, 2001)) were used in this study's sample. This subsample (SIC 2834) has been used in various empirical studies (e.g., Markman et al., 2004; Rothaermel, 2001). Furthermore, this sample was restricted to this industry category because all firms in this subsector involve the development of drugs that are subject to FDA regulations. 8 firms were also removed because of missing alliance data. This resulted in a panel data set of 97 firms over the period of 1999 to 2004<sup>19</sup>.

The panel data set is advantageous for empirical research of this type because it increases the degrees of freedom and reduces the collinearity among explanatory variables and thereby improving the efficiency of econometric estimates (Hsiao, 1986). In addition, panel data estimations, such as 'fixed effect estimations', can account for unobserved heterogeneity in the statistical analysis (Cameron, 1998). Since our unit of analysis is focused on the firm level, a high degree of unobserved heterogeneity is expected among firms in the sample. More specifically, a firm's given explanatory variables, such as the firm's return relative to its reference point, and risk taking in a technology development, are expected to be significantly affected by the firm's own unobserved features such as different resources and experience. Furthermore, ANOVA test also shows that there is very significant fixed effect (Baltagi, 2001; Hsiao, 1986).

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<sup>19</sup> The firms and years in this panel data set are same as those of 2<sup>nd</sup> essay of my dissertation. However, specific variables, such as dependent variables and explanatory variables, of this study are all different from those of 2<sup>nd</sup> essay.

## Dependent Variables

**Risk preference in alliance formation; risk taking and risk aversion.** A firm's choice of different risk alliances reflects its risk preference. Risk preference is measured by the ratio of high (or low) risk alliance to total alliances. Specifically, the risk taking is constructed by the ratio of high risk alliance to total alliance while the risk aversion is constructed by the ratio of low risk alliance to total alliance. In drawing on empirical measures, the high risk alliance is a count measure of the sum of the following types of agreements found in Bioscan: basic research, drug discovery and development. While, low risk alliances is a count measure of the sum of commercializing agreements that consists of clinical trials, FDA regulatory process, and marketing and sales (Rothaermel & Deeds, 2004: 209-210).

The key equation we estimate is as follows. Because this equation (equation 2) is estimated to see the effect of the explanatory variables on the risk preference - risk taking and risk aversion- in alliance formation, equation 2 is distinct to the equation 1. The purpose of equation 1 is to get RRRP measure for equation 2. The hypotheses of this study will be tested with results of the equation 2.

$$\text{Equation 2: Risk preference}_{t+1} = \beta_0 + \beta_1 * \text{RRRP\_below}_t + \beta_2 * \text{RRRP\_above}_t + \beta_3 * \text{Risk taking in technology}_t + B * \text{Control variables}_t + \Gamma_{it},$$

where *Risk preference*<sub>t+1</sub> is a firm's risk taking and risk averse choices of alliance risk, *RRRP\_below*<sub>t</sub> is the firm's performance (ROA) that falls below the reference point, *RRRP\_above*<sub>t</sub> is the firm's performance (ROA) that falls above the reference point, *Risk taking in technology*<sub>t</sub> is a firm's experience in undertaking new technological

developments,  $B$  is coefficients of control variables and  $\Gamma_{it} = \gamma_i + \Phi_{it}$ , in which  $\gamma_i$  is a heterogeneous firm's fixed effect component of error term  $\Gamma_{it}$ ,  $i = 1, 2, 3 \dots 97$ ,  $t = 1, 2 \dots 5$ . We estimate one equation for risk taking and another for risk aversion. We compared the results to test hypotheses.

### **Explanatory Variables**

**Relative return to a reference point (RRRP).** Based on Lehner's (2000) approach to find the reference point, the RRRP is constructed by the difference between a firm's current return on asset (ROA) and the estimated reference point. RRRP thereby takes negative and positive values that respectively indicate a low and high RRRP. We used notation of *RRRP\_above* and *RRRP\_below* for the high and low RRRP respectively.

**Risk taking in a new technology development.** A firm's risk taking in a new technology is constructed by counting the number of patents in a new field in which a firm has not created any patents during the past 5 years. Specifically, the patents that "a firm successfully filed for in year  $t$  within patent classes in which the firm has not been active in the 5 years prior to the given year" are counted (Nooteboom et al, 2007:1022). However, we constructed a ratio of such patents' classes over the total number of classes to represent a firm's choice for risk taking in a new technology development. The 5-year window is also common in the related literature that attempted to proxy a firm's innovativeness in a new technology development (Ahuja, 2000; Henderson & Cockburn, 1996; Nooteboom et al, 2007; Rothaermel & Deeds, 2004; Stuart & Podolny, 1996;

Silverman & Baum, 2002). The data of patents were collected from United States Patent and Trademark Office (USPTO) database.

### **Control Variables**

As the formation of a firm's alliances (high / low risk) can be influenced by other than prospect theory explanation, we have controlled for other explanations. We controlled for a firm's size and age which are most common control variables in alliance formation research. The size and age may have influential effects on the formation of high / risk alliances because larger and older firms have more resources and experience than smaller and younger firms (Park et al., 2002; Park & Zhou, 2005). As a result, with greater resources and experiences, these firms are more likely to support the costs and experiences required for high risk alliances. The firm size is measured by the number of employee, while a firm age was measured based on its founding year (e.g. Powell et al., 1996; Rothaermel & Deeds, 2004, 2006; Shan et al., 1994; Silverman & Baum, 2002).

### **Model Specification and Estimation**

Our data set is a panel data which consist of 6 years of 97 cross-sectional units. Because the 97 pharmaceutical firms may have their own unique characteristics, such as unique resources and capabilities, which are not easily observable (Barney, 1991) but can have a statistically significant effect (Powell et al., 1996), panel data analysis especially with fixed effect estimation is appropriate (Baltagi, 2001; Hsiao, 1986; Powell et al., 1996). Specifically, we use fixed effect estimation of this panel data because

random effect estimation are based on an assumption that individual effects are uncorrelated with the explanatory variables, i.e., if unobserved effects are correlated with the explanatory variables, the random effects estimators are inconsistent (Baltagi, 2001; Cameron, 1998; Mundlak, 1978).

The panel data was estimated through a generalized method of moment (GMM) estimation with consideration of fixed effects on each firm because GMM is a relatively robust estimation method. That is, GMM does not require any exact distribution assumptions on the disturbance terms while maximum likelihood estimation (MLE), a popular estimation method, requires an exact distribution assumption to estimate a model. In addition, many common estimators such as OLS, IV, 2SLS and even MLE are special cases of GMM (Hamilton, 1994).

The GMM draws out the estimates of parameters with which the correlations between disturbances and instrumental variables are as close to zero as possible. However, the validity of the instrumental variables should be tested when the number of instrumental variable is greater than the number of coefficient estimated (Newey & West, 1987a). Because researchers usually use the lagged variables of explanatory variables including constant term (e.g. Hansen & Singleton, 1982), this study also adopted this approach. Because GMM can be also robust to heteroskedasticity and autocorrelation with a proper weighting matrix (Newey & West, 1987b), this study uses the

heteroskedasticity robust GMM.<sup>20</sup> We used EVIWS 5.1 of Quantitative Micro Software (QMS), an econometric analysis package, for the whole estimations and statistical tests.

### Estimation Result

For our examined variables, table 4 shows their means, standard deviations, and bivariate correlations. The descriptive statistics shows that the high risk alliances on average reflect 43% of the sample. The average firm of our sample data is also 35 years old and has 11640 employees. The average firm's risk, i.e., volatility of its return, is 28.643 and the new field classes of the average firm's patent reach 53% of total classes. The average return on asset (ROA) is -19.159. The average size of deviation below the reference point is 10.426 and the average size of deviation above the reference point is 20.428. The descriptive statistic table shows that the correlation between a firm's ROA and the size of deviations from the reference point is high because the deviations, RRRP\_Below and RRRP\_Above, are constructed by the difference between a firm's current ROA and its reference point. Readers should however note that these variables (ROA and RRRP\_Below, or ROA and RRRP\_Above) are not used concurrently in any model.

The hypotheses were tested by estimating equation 2 through GMM method. Their results are shown in Table 5. The hypothesis 1a and 1b were used to examine

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<sup>20</sup> We also checked autocorrelation with error terms of the equations, i.e. whether the error term  $E_{it} = \delta_i + U_{it}$  and  $U_{it} = \rho U_{it-1} + \varepsilon_{it}$ , in which  $\delta_i$  is a heterogeneous firm's fixed effect component of error term  $E_{it}$ . The  $\rho$  was not significant at 5% significance level with suggestion of no autocorrelation.

Table 4  
The Descriptive Statistics

Variables	Mean	S.D.	1	2	3	4	5	6	7	8
1. Risk taking in alliance formation	0.428	0.310	1.000							
2. Firm Age	35.232	44.361	0.041	1.000						
3. Firm size	11.636	25.874	0.191	0.592	1.000					
4. Risk in return	28.634	32.372	-0.147	-0.359	-0.333	1.000				
5. Success experience in risk taking	0.529	0.308	0.039	0.064	0.111	-0.195	1.000			
6. ROA	-19.159	37.587	0.037	0.383	0.381	-0.492	0.081	1.000		
7. RRRP_Below	-10.426	26.047	0.064	0.181	0.179	-0.400	0.048	0.911	1.000	
8. RRRP_Above	20.428	17.520	-0.016	0.551	0.552	-0.461	0.102	0.791	0.468	1.000

S.D. is standard deviation. ROA has high correlations with RRRP\_Below and RRRP\_Above because RRRP\_Below and RRRP\_Above are constructed by the difference between a firm's current ROA and its reference point. But they (ROA and RRRP\_Below, or ROA and RRRP\_Above) are not used simultaneously in any model.

Table 5  
The Result of Estimation on Risk Preference in Alliance Formation

Variable	Risk taking	Risk avoiding
Constant	1.8136*** (0.4334)	-0.78829 (0.6457)
Relative Return below Reference Point	-0.00129*** (0.0002)	0.00129*** (0.0002)
Relative Return above Reference Point	-0.00896*** (0.0021)	0.00885** (0.0028)
Risk Taking Experience in a New Technology	-0.94751* (0.3852)	0.9631 <sup>†</sup> (0.4940)
Firm Age	-0.01808 (0.0128)	0.01771 (0.0162)
Firm Size	-0.00188 (0.0071)	0.00079 (0.0114)
R-squared ( $R^2$ )	0.69675	0.69294
Adjusted R-squared ( $\bar{R}^2$ )	0.45195	0.44506
Sum of squared residuals	3.84165	3.88992
J-statistic	2.09389	2.10801

Standard errors in parentheses. <sup>†</sup>  $p < 0.1$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .



whether the study's use of prospect theory arguments are supported in alliance risk preference context. Specifically, hypothesis 1a was tested to determine whether risk taking in alliance formation increases as a firm's return falls below its reference point. However, the interpretation should be carefully made because the value of the 'relative return below the reference point' (RRRP\_below) is a 'negative' value<sup>21</sup>. The estimated result shown in table 5 shows that as a firm's relative return below the reference point increases (i.e. smaller deviation from the reference point), the firm's risk taking is significantly decreased at the significance level of 0.001 (i.e.,  $\beta_1 = -0.001285$ ,  $t$ -statistic = 5.625679 for risk taking in alliance formation). Stated differently, as a firm's return is departed away from below the reference point, the firm's risk taking in alliance formation is significantly increased. That is, the increases in magnitude of departure from below reference point positively influence the incidence of high risk alliances. Furthermore, this is also consistent with a firm's risk aversion in alliance formation. That is, to be consistent in logic, if the risk taking is increased, then the risk aversion should be decreased. The result supports the case of the risk aversion. Namely, the firm's risk aversion is significantly decreased as a firm's return falls away from below the reference point (i.e.,  $\beta_1 = 0.001290$ ,  $t$ -statistic = 3.119383 for risk aversion in alliance). That is, the increase in the magnitude of departure from below the reference point negatively influences the incidence of low risk alliances. Thereby we can not reject the hypothesis 1a.

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<sup>21</sup> Hence, the increase in the nominal value of the relative return below the reference point (RRRP\_below) means the decrease in the absolute value of the relative return.

Hypothesis 1b was tested to determine whether risk aversion in a firm's alliance formation increases as a firm's return falls above the reference point. The estimation result shows that as a firm's return exceeds the reference point, the risk aversion in alliance is significantly increased at the significance level of 0.01 (i.e.,  $\beta_2 = 0.008852$ ,  $t\text{-statistic} = 3.119383$  for risk aversion in alliance). That is, the increase in the magnitude of departure from above the reference point has positive (negative) effect on risk aversion (risk taking) in alliance formation. Furthermore, this is also consistent with the result that the deviation from above the reference point has a significantly negative effect on risk taking in alliance formation at the 0.001 level of significance (i.e.,  $\beta_2 = -0.008964$ ,  $t\text{-statistic} = -4.297044$  for risk taking in alliance). Thereby, we can not reject the hypothesis 1b.

The results of hypothesis 1a and 1b are depicted in figure 3. As Greve (1998) argued, this type of graph as in figure 3 can be utilized to support the reasoning of prospect theory or behavioral theory. That is, there is significant break in the slopes of risk preference depending on reference point implying that a firm's risk preference is significantly changed at the reference point. Specifically, a firm's risk taking in alliance formation is negatively sloped while risk aversion in alliance formation is positively sloped. However, common to both the risk taking and risk aversion curves, there is a 'break' in their own slopes between below the reference point and above the reference point. The Wald test to examine the equality of coefficients, i.e., slopes, between the below the reference point and the above the reference point shows that the 'break' is significant (i.e.,  $p=0.001$ ,  $\beta_1 = -0.001285$ ,  $\beta_2 = -0.008964$  for risk taking while

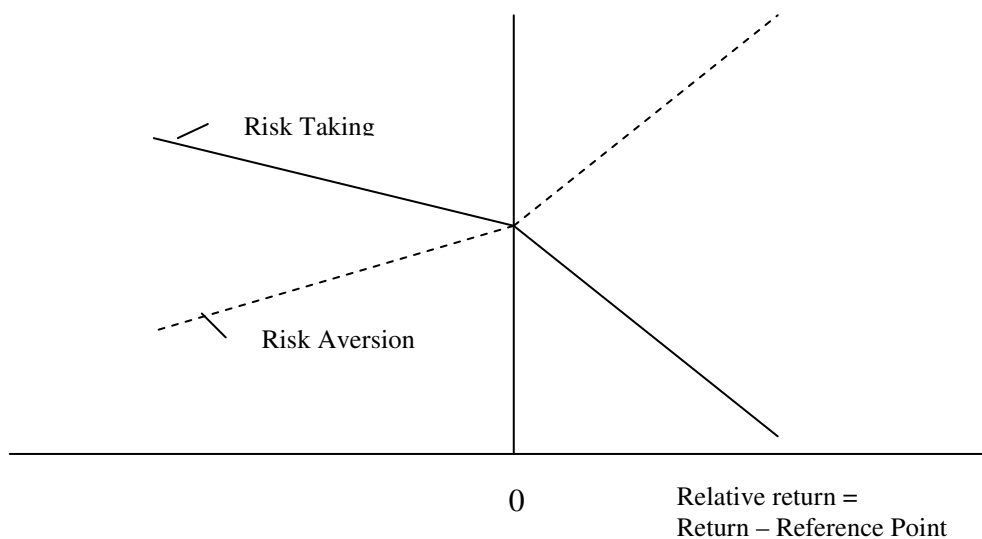
$p=0.001$ ,  $\beta_1 = 0.001290$ ,  $\beta_2 = 0.008852$  for risk aversion ). This means that as a firm's return increases, risk taking (risk aversion) decreases (increases) more slowly below the reference point than above the reference point. Greve argued that "probability of change may decrease more slowly below the aspiration level" (1998: 61) due to inertial effect even though his empirical finding did not fully support it. This study finds support for this argument. This tendency is consistent with arguments of prior research, such as a firm's preference for a current state to a new state (Hannan & Freeman, 1984) even to commitment to failing courses of action (Staw, 1976; Staw, Sandelands, & Dutton, 1981). Firms will keep taking high risks when a firm's return is below its reference point or aspirations. That is, although a firm's current strategic actions are not making profits as expected, the firm tends to be still committed to the actions even to harm the firm itself (Staw, 1976; Staw, Sandelands, & Dutton, 1981). This is in a sense consistent with empirical findings that troubled firms takes more risk which leads to worse performance (Bowman, 1982; Bromiley, 1991). However, this tendency of self reinforcing is drastically changed as the frame is changed from 'loss' to 'gain' as in prospect theory (Kahneman & Tversky, 1979). Hence, the graphs in figure 3 are also consistent with prospect theory or behavioral theory as Greve (1998) argued.

The hypothesis 2 was also tested through estimating equation 3. As shown in table 5, the past risk taking experience in a new technology development has a significantly negative effect on high risk alliances (i.e.,  $p=0.01$ ,  $\beta_3 = -0.94751$ ,  $t\text{-statistic} = -2.459631$  for risk taking in alliance formation). This is also supported by its positive effect on low risk alliance at a significance level of 0.1 ( $\beta_3 = 0.963098$ ,  $t\text{-statistic} =$

1.94974 for risk avoiding in alliance formation). Thereby, we can not reject the hypothesis 2. This result is also consistent with prospect theory explanation whereby risk taking in alliance formation is decreased with accumulation of innovative technologies.

The estimation shown in table 5 also shows that control variables, such as firm age and firm size, have negative impacts on high risk alliances while positive impacts on low risk alliance though they are not statistically significant.

Figure 3  
Relative Return to Reference Point and Risk Preference



## DISCUSSION AND IMPLICATIONS

This study has examined a firm's strategic risk behavior to address the 'risk / return paradox' in alliance formation. In particular, this study draws on prospect and related behavioral theories to give an explanation to the question of why firms form

highly risky alliance when they generate low returns. According to prospect and related behavioral theories, a firm's risk preference, i.e., risk taking and risk aversion, is dependent on its returns relative to a reference point or aspiration level. This study empirically shows that such reasoning of prospect and related behavioral theory is applicable to alliance choices. That is, firms have a preference for taking on riskier alliances when a firm's return falls below its reference point. Conversely, a firm's risk aversion through its selection of low risk alliances tends to increase as a firm's return falls from above the firm's reference point. We also found that past risk taking in the development of a new technology reduced formation of high risk alliances.

This study offers an initial attempt to extend prospect and related behavioral theory arguments to the study of risk preferences, as it relates to alliance choice. This study has contributed to alliance research at least in three aspects. First, to our knowledge, there is no empirical research about the relationship between risk preference and alliance formation. This has been partly because it is not easy to measure alliance risk (Arend, 2004; Bromiley et al., 2001; Das & Teng, 1996, 2001). To address this we classified the alliances into high and low risk alliances. We also assumed that a firm's risk preference is embedded in its strategic choice. Second, a firm's risk preference has not been considered as a factor that impacts in the formation of an alliance. This has been partly because risk attitude has been largely assumed to be as fixed as in the financial portfolio theory (Bromiley et al., 2001). Finally, the empirical study about the effect of past risk taking experience on future alliance formation was not conducted in alliance research. In that regard, this study also will contribute to the research stream

about the effect of experience on alliance formation (e.g. Anand & Khanna, 2000; Hoang & Rothaermel, 2005; Kale et al., 2002; Rothaermel & Deeds, 2006; Zollo et al., 2002).

This research also contributes to risk related research, especially prospect theory research. Because the prospect theory was originally based on individual risk behavior, the further extension of prospect theory to firm level research has been increasingly sought (e.g., Chang & Thomas, 1989; Fiegenbaum, 1990; Fiegenbaum et al, 1996; Fiegenbaum & Thomas, 1988; Lehner, 2000; Singh, 1986). In that regard, this study contributes to the further extension of prospect theory by extending it to the examination of alliances.

However, there are also several limitations in this study which will be subjects of future research. First, although the classification of different risky alliances into high and low risk alliances is generally accepted in alliance research (e.g., Park et al., 2002; Powell et al., 1996; Rothaermel & Deeds, 2004), it may be too simplistic. As Miller and Bromiley (1990) argued, because different measures of risk may represent different dimensions of risk, the development of other risk measures to classify alliances would contribute to enhanced understanding of alliance risk. Finally, in future research, this study can be extended to examine inter-firm level validity of prospect theory because strategic alliances between firms can be utilized for the inter-firm level research.

## **CHAPTER V**

### **GENERAL DISCUSSION AND CONCLUSION**

This dissertation sought to address the shortcomings of resource based view (RBV) regarding the origins and processes of value creation (chapter II), the shortcomings of alliance management capability (AMC) approach regarding determinants of alliance formation (chapter III), and the shortcomings of traditional portfolio theory based approach regarding risk preference in alliance formation (chapter IV). Even though each chapter is distinct in its research objective, there are some relationships among the chapters. We discuss the relationships among the chapters here.

First of all, there are relationships between arguments of chapter II and chapter III at least in two aspects. The first thing is about the argument on a firm's external competition. Chapter II predicated that competition has dual impacts on the opportunity of value creation that comes from cognitive and operational gaps of stakeholders. That is, due to competitive exploitation of the value opportunity, the opportunity is increasingly decreased, but as a result, there is also increase in the pressure on firms to create new value opportunities for their survival. We argued competition increases a firm's creation of new value opportunities. The impact of the competition on alliance (chapter III) was revealed as promotion of alliance formation and especially the formation of explorative alliances because alliances, especially explorative alliances, serve to searching for new value opportunities (Koza & Lewin, 1998). That is, competition promotes the formation of alliances because by gaining access to new resources and experiences, firms can

develop new sources of value creation (e.g., Eisenhardt & Schoonhoven, 1996; Park et al., 2002; Patzelt et al., 2008; Shan, 1990). Especially, competition promotes the explorative alliances that promote coordination of diverse partnerships to which promote innovation (e.g. Nicholls-Nixon & Woo, 2003; Rothaermel & Deeds, 2004; Shan et al., 1994). The promotion of alliance formation and especially the formation of explorative alliance were empirically supported at chapter III. Thus there was consistency in argument on competition between chapter II and chapter III.

The second relationship between arguments of chapter II and chapter III is about the function of a firm's absorptive capacity. Chapter II asserted that a firm's absorptive capacity serves to exploitation of value opportunity derived from a firm's cognitive and operational gaps. The path dependency of a firm's absorptive capacity encourages exploitation of its prior experience but rather prevents creation of new value opportunities. This impact of the absorptive capacity was revealed as promotion of formation of exploitive alliances but reduction of that of explorative alliances in the context of alliance (chapter III). The function of absorptive capacity in exploitation of value opportunity was consistently revealed in the context of alliance formation such as promotion of exploitive alliances.

With respect to the relationship between chapter III and chapter IV, a certain empirical finding in chapter III is closely related to a research question of chapter IV. Specifically speaking, despite the diminishing return effect of alliances, total alliance formation was monotonously increased regardless of a firm's Relative AMC (RAMC). According to the logic of diminishing return effect of alliances, when a firm's AMC falls



above the diminishing return point, firms will reduce or not increase further alliance formation. Yet, firms still increased the alliance formation even though their AMC already exceeded the diminishing point. This unexpected result raised a fundamental question of why a firm forms risky alliances with low return. Furthermore, explorative alliances which are more risky than exploitive alliances were more formed. Such a finding raised a question against a traditional risk preference, such as in financial portfolio theory. Such research question was addressed by the study in chapter IV. That is, when a firm's return falls below its reference point or aspiration level, the firm forms the high risk alliance with low return as expected in prospect theory and behavioral theory (e.g., Bromiley, 1991; Fiegenbaum & Thomas, 1988; Kahneman & Tversky, 1979; March & Shapira, 1987). Furthermore, this tendency to form the high risk alliance is reinforced when a firm's return departs away from below its reference point or aspiration level.

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## APPENDIX A

### EXAMPLES OF SUBCLASSES OF A PATENT WITH CLASS OF 424

Class	Subclass	Description
424		DRUG, BIO-AFFECTING AND BODY TREATING COMPOSITIONS
	.	
	.	
	.	
		IMMUNOGLOBULIN, ANTISERUM, ANTIBODY, OR ANTIBODY
	130.1	FRAGMENT, EXCEPT CONJUGATE OR COMPLEX OF THE SAME WITH NONIMMUNOGLOBULIN MATERIAL
	131.1	Anti-idiotypic
	132.1	Derived from transgenic multicellular eukaryote (e.g., plant, etc.)
	133.1	Structurally-modified antibody, immunoglobulin, or fragment thereof (e.g., chimeric, humanized, CDR-grafted, mutated, etc.)
		Antibody, immunoglobulin, or fragment thereof fused via peptide linkage to
	134.1	nonimmunoglobulin protein, polypeptide, or fragment thereof (i.e., antibody or immunoglobulin fusion protein or polypeptide)
	135.1	Single chain antibody
	136.1	Bispecific or bifunctional, or multispecific or multifunctional, antibody or fragment thereof
	137.1	Binds specifically-identified oligosaccharide structure
	138.1	Binds expression product or fragment thereof of cancer-related gene (e.g., oncogene, proto-oncogene, etc.)
	139.1	Binds antigen or epitope whose amino acid sequence is disclosed in whole or in part (e.g., binds specifically-identified amino acid sequence, etc.)
	.	
	.	
	.	
	177.1	Reduced antigenicity, reduced ability to bind complement, or reduced numbers of activated complement components (e.g., free from aggregated, denatured, fragmented, or polymerized immunoglobulins; free from proteolytic enzymes, etc.)
		CONJUGATE OR COMPLEX OF MONOCLONAL OR POLYCLONAL
	178.1	ANTIBODY, IMMUNOGLOBULIN, OR FRAGMENT THEREOF WITH NONIMMUNOGLOBULIN MATERIAL
		Conjugated via claimed linking group, bond, chelating agent, or coupling agent
	179.1	(e.g., conjugated to proteinaceous toxin via claimed linking group, bond, coupling agent, etc.)
	180.1	Conjugate includes potentiator or composition comprising conjugate includes potentiator
	181.1	Conjugated to nonproteinaceous bioaffecting compound (e.g., conjugated to cancer-treating drug, etc.)
	182.1	Conjugate includes potentiator; or composition comprising conjugate includes potentiator
	183.1	Conjugated to proteinaceous toxin or fragment thereof (e.g., conjugated to diphtheria toxin, Pseudomonas exotoxin, ricin, gelonin, abrin, etc.)
	.	
	.	
	.	

Source: USPTO, <http://www.uspto.gov/go/classification/uspc424/sched424.htm>.



## APPENDIX B

### EXAMPLE OF CALCULATION OF COMPETITION EXTENT OF A FIRM

Company	Year	Class/subclass	USPTO	Own	Rival	Repetition
Firm A	2001	530/331	71	2	69	1
		514/400	41	1	40	1
		544/254	8	1	7	1
		544/116	17	1	16	1
		514/19	79	2	77	1
		424/423	184	1	183	1
		424/85.7	14	1	13	1
		514/183	114	5		5
		514/341	60	1	59	1
		514/241	45	1	44	1
		540/500	9	3	6	1
		514/254.08	7	1	6	1
		435/285.2	34	1	33	1
		514/183	114	5		5
		514/217.06	17	2	15	1
		514/183	114	5		5
		514/183	114	5		5
		562/450	10	1	9	1
		514/215	20	1	19	1
		514/470	19	1	18	1
		514/17	43	1	42	1
		514/183	114	5	109	5
		514/378	49	1	48	1
		540/460	11	1	10	1
Average					41.15	

We modified (removed 10 patents) the patents of Vertex Pharmaceuticals, Inc. of 2001 to make an example. 'Class/subclass' is a firm's individual patent's class and subclass. 'USPTO' means total number of the patents with a specific class/subclass in the USPTO database while 'Own' means firm A's number of the patent. 'Rival' = 'USPTO' – 'Own'. 'Repetition' indicates the number of same patents, i.e., patents with same class and subclass within the firm A. Note: a patent may have several class/subclass classifications by examiners of USPTO, but the first one, i.e. the first class/subclass is regarded as the patent's main classification. However, we also considered second or third class/subclass for counting the 'Own' in the above table because of its indirect relations. The patents which do not repeatedly appear on column of 'Class/subclass' but has more counts than 1 in the 'Repetition' is that kinds of patents.

## APPENDIX C

### CORRELATIONS AMONG Q-TRANSFORMED VARIABLES

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1. Explorative alliance	-0.05	2.75	1.00									
2. Exploitive alliance	-0.03	3.21	0.79	1.00								
3. Age	0.09	1.38	-0.39	-0.42	1.00							
4. Size	0.00	3.54	-0.33	-0.36	0.20	1.00						
5. Technology diversity	-0.01	1.48	0.07	0.20	-0.17	-0.05	1.00					
6. Innovativeness	0.34	41.81	0.00	-0.07	0.02	0.06	0.22	1.00				
7. RAMC_below	0.06	2.34	-0.43	-0.40	0.39	0.14	-0.16	0.00	1.00			
8. RAMC_above	0.00	4.06	0.73	0.84	-0.32	-0.35	0.21	0.09	-0.21	1.00		
9. R&D intensity	0.17	56.94	0.02	-0.01	0.02	0.00	-0.01	0.00	0.00	0.00	1.00	
10. Competition	-2.18	154.32	0.04	0.07	-0.24	-0.01	0.06	-0.01	-0.09	0.04	-0.04	1.00

Because the explorative alliances and exploitive alliances comprise a firm's total alliances, they are highly correlated. We also checked whether the error terms of the two equations (the two variables are dependent variable at each equation) are contemporaneously correlated as in a seemingly unrelated regression (SUR) model (Greene, 1997). We also corrected the contemporaneous correlation using weighting matrix in GMM estimation (Newey and West, 1987b).

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